OFFICIAL JOURNAL OF AMERICAN COLLEGE OF SURGEONS
ANNUAL SUBSCRIPTION: UNITED STATES AND CANADA, $12.00; FOREIGN, $14.00

Volume XXXI OCTOBER, 1920 Number 4

OCT 4 1920

Surgery, Gynecology and Obstetrics

WITH

International Abstract of Surgery

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Entered as second-class matter May 22, 1913, at the postoffice at Chicago, Ill., under the Act of Congress, March 3, 1879.
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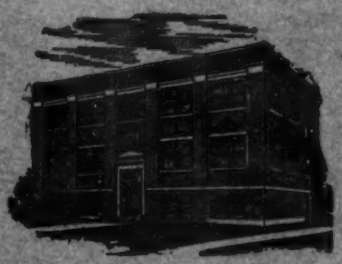

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Plate I. Showing the presence of a stricture at the lower end of the ureter above which can be seen the presence of leukoplakia. The mucosa of the ureter is very red.

Leukoplakia of the Bladder and Ureter.
Herman L. Kretschmer.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXXI OCTOBER, 1920 NUMBER 4

LEUKOPLAKIA OF THE BLADDER AND URETER[1]

BY HERMAN L. KRETSCHMER, M.D., F.A.C.S., CHICAGO

Urologist, Presbyterian Hospital; Genito-Urinary Surgeon, Alexian Brothers Hospital

THE majority of authors who have written upon the subject of leukoplakia of the urinary organs agree that it is a rare disease Brik is one of the few, however, who does not believe that it is of rare occurrence. Beer also thinks the disease is more frequent than statistics would lead one to believe. That this pathological condition is not of very frequent occurrence is evidenced by the fact that the literature on this subject, including the case reports, is not extensive. For example, in the American literature at my command I was able to find only three contributions on this subject, namely, those of Arthur T. Cabot, Zipser, and Beer. Not only are the case reports few and far between, but in some of them the more important details are lacking. Because of the fact that the literature on this subject is very scattered, it was thought desirable to collect and briefly to review such cases as were available, especially as I have been unable to find a complete and comprehensive review of the subject in the literature of this country. Whether or not this condition is really as rare as I am led to believe, can be determined only by the number of cases that are reported; hence, it is my hope that this article may interest those who have seen similar cases, to the end that they will report cases in their practice. Not only will the placing on record of these cases give us a more accurate account of the frequency of occurrence of this condition, but new facts may be brought forth that may throw additional light on the subject.

Before discussing the cases reported in the literature, I shall present briefly the following case:

Mr. A. K., age 54, a machinist by occupation, was referred by Dr. Walter Stauffer, of Elkhart, Indiana, and was admitted to the Presbyterian Hospital, September 26, 1919. Family and previous histories were negative. The patient denied having had gonorrhœa or syphilis. His chief complaints were: (1) pain in the region of the left kidney, (2) passing sand and gravel in the urine, (3) burning on urination, (4) frequency of urination, (5) hæmaturia, and (6) pus in the urine.

Onset and course. The patient stated that his trouble began 15 years ago after a very severe cold. At that time he had severe burning on urination; he was obliged to urinate every few moments and passed small amounts of blood with the urine. About the same time, he first noted severe pain in the region of the left kidney. Since the onset the attacks of pain had been irregular; sometimes he had one attack every month and there were times when he would be free from attacks for 6 months.

Pain in region of kidney. The attacks were ushered in very suddenly, with sharp, severe pain over the left kidney. The pain radiated to the bladder and then left as suddenly as it started. The attacks usually lasted from 15 minutes to one-half hour. The pain was somewhat relieved by urination; but hypodermic injections of morphine always gave him complete relief. After he received the hypodermic he would fall asleep and wake up free from the pain. The last attack was present for 2 weeks. The pain had been almost constant, only easing up for a few minutes at a time. During this last attack *hypodermics failed to give relief.* The pain was described as cramp-like in character and was so

[1] Read before the American Urological Association March 23-25, 1920, New York City.

severe that it doubled him up. Sometimes there was a grating, unbearable pain along the course of the left ureter.

Passage of sand and gravel in urine. The passage of sand (?) and gravel (?) was first noticed several years after the onset of his present trouble. At times he passed small amounts of sand with every urination. He, furthermore, stated that he had passed about six or seven *large pieces of gravel* since the onset of his trouble and that these were passed at times with severe pain. The discharge of gravel is accompanied by great pain and burning in the bladder. The last one was passed 7 days before admission and was as large as the tip of his little finger. Usually, however, the gravel passed varied in size from a millet seed to a small grain of wheat.

Burning on urination. This was present from the onset of his trouble and was only noted during the act of urination.

Frequency of urination. During the day he voided every hour and sometimes every half-hour. He urinated more frequently during the attacks of pain, and urination seemed to relieve the pain. As a rule, he voided two or three times during the night. At the time of admission the frequency was much less marked than it had been.

Hæmaturia. The patient stated that he occasionally passed small specks of blood in the urine. He never passed large clots and the blood was never well mixed with the urine.

Pus in the urine. He often noticed that he passed some white material with the urine. This he said was pus.

He never had had retention of urine. Nausea was present during the attacks of renal pain.

Physical examination. The patient was a small, fairly well-nourished male, appearing to be about 54 years of age. The head and neck were negative. The pupils were equal and reacted to light and accommodation. The nose was negative. The mouth showed many carious teeth. The tongue was clear and moist and showed no tremor.

The chest was barrel-shaped and the lung expansion poor. There was normal vesicular breathing; no râles.

Heart borders were normal; tones clear; rhythm and rate normal.

There was some rigidity of the left rectus muscle. There was a good deal of rigidity in the region of the left kidney and along the course of the left ureter. The kidneys were not palpable. The spleen was not palpable. The liver was palpable 3 fingerbreadths below the costal arch.

There was no œdema of the lower extremities and no scars were seen. Knee-jerks were present.

Rectal examination. The prostate was normal in size, or perhaps a little smaller than normal. The seminal vesicles were palpable. Above the prostate and seminal vesicles at about the peritoneal fold was felt a hard, irregular, nodular infiltration that was more or less crescentic in outline and seemed to extend equally on both sides of the median line.

Because of a sudden onset of œdema of the left leg several weeks after admission to the hospital, James B. Herrick was asked to see the patient. The physical examination made by Dr. Herrick showed the following: A double inguinal hernia was present. A hard nodule was felt in the left inguinal ring when the patient coughed. The liver was palpable 3 fingerbreadths below the costal margin. The umbilicus was very hard in the center. There was an enlarged left axillary gland the size of a bean. The right kidney region was tender. The left leg was œdematous to the knee and the right leg was œdematous halfway to the knee.

Examination of the blood showed 4,300,000 erythrocytes; 7,700 leucocytes; 88 per cent hæmoglobin. Blood pressure was 120 systolic, and 70 diastolic. The spinal Wassermann reaction was negative.

Roentgen-ray examination by H. E. Potter showed no shadows suggestive of stone in the upper urinary tract. There was seen one shadow on the left side low down that might have been due to a stone in the ureter. This was really out a little farther than the average stone we see in the ureter.

Urinalysis showed color, amber; specific gravity, 1030; reaction, alkaline; albumin, positive; a trace of blood; sugar, negative. Microscopically, red blood cells and amorphous phosphates were present. Cultures of the urine showed a mixed culture of bacillus coli and staphylococcus. Cell count: 4,600 leucocytes per cubic millimeter.

Cystoscopic examination. The entire bladder mucosa seemed to be covered with white material except at the apex, where an area of very red mucosa. the size of a dime was seen. The bladder had a pale, grayish-white, lusterless appearance. Nowhere was anything resembling mucosa visible except in the apex, and there it appeared very red. The cystoscopic picture was typical of leukoplakia vesicæ. Blood vessels were not seen except in the small area of mucosa at the apex. No individual plaques were seen. No stone or tumor was seen. The ureteral orifices appeared normal. Catheterization of the right ureter was easy and without obstruction. Examination of the urine from the right side showed the presence of pus cells, 2,507 per cubic millimeter. Cultures showed the presence of staphylococci. Six attempts were made to catheterize the left ureter. Each time an obstruction was met about 2 centimeters up, beyond which point it was impossible to advance the catheter.

Intravenous injection of phenolsulphonepthalein showed:

Time of appearance	7 minutes
First half-hour	47 per cent
Second half-hour	22 per cent
Total function	69 per cent

Examination for residual urine showed that the patient emptied his bladder completely.

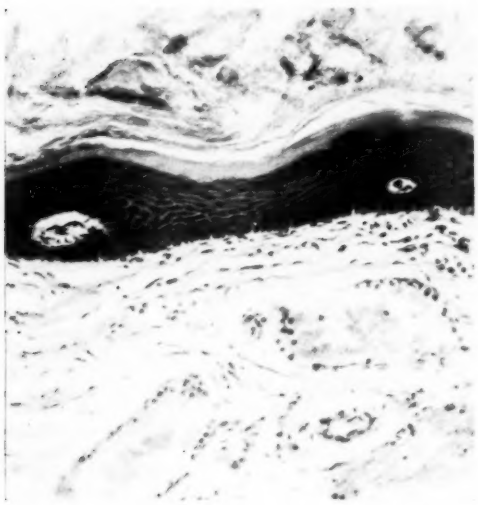

Fig. 1. The mucosa is very narrow and the cells are flattened and placed at right angles to the basal layer of columnar cells. Large collections of desquamated squamous cells can be seen adhering to the surface of the mucosa.

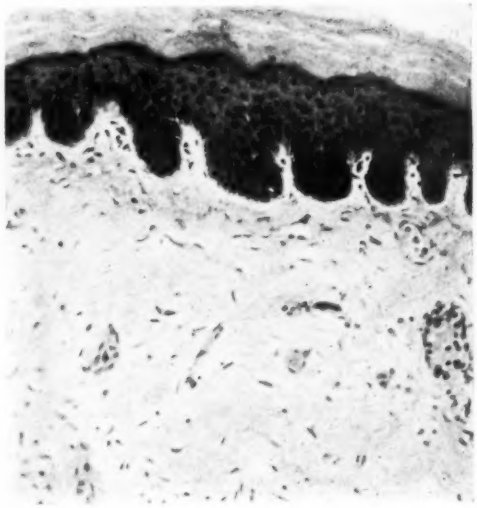

Fig. 2. Lamellæ of desquamated cells adhering to the surface of the mucosa. Tendency toward formation of papillæ.

The patient was put upon the internal administration of urotropin and acid sodium phosphate, alternating each week with sodium bicarbonate. Daily irrigations of potassium permanganate were instituted.

Dr. Herrick was of the impression that besides the urinary condition the patient also had a carcinoma, probably of the stomach. In order to clear up this point the following examinations were made:

November 7, 1919, examination of the stomach contents showed free hydrochloric acid, 1+; lactic acid, 2+1; mucus, 1+; tumor fragments, none; long bacillus, 3+.

November 8, 1919, total acidity, 52; free hydrochloric acid, none; combined and other acids, 50; microscopic blood; no pus; no mucus.

November 8, 1919, a barium meal was given and the patient fluoroscoped. The barium solution entered rapidly, but filled the upper part of the stomach first as a large, rather circular region, and then spread down to the pyloric region as a long, narrow portion which gradually filled out to normal size and shape. There was no peristaltic change and the pylorus closed off uniformly, although there was some question as to the widening in the pyloric region.

Fluoroscopy of the colon by Dr. Rose. The barium solution entered in a spasmodic manner, especially in the sigmoid region, where there was a questionable area which later seemed to fill fairly well. The cæcal region filled well. The transverse colon contained gas but very little barium. The sigmoid was spastic. There is probably no carcinoma.

Analysis of the fæces showed no blood, pus, or mucus.

The patient was kept on local treatment for the bladder condition and attempts were made to relieve his renal colics by dilating the lower left ureter, the condition of which was diagnosed as stricture. As previously mentioned, many attempts were made to catheterize the left ureter, all of which failed. Dr. Herrick still believed that besides the urinary condition the patient had a carcinoma somewhere in the abdomen, and was of the opinion that the mass which could be felt through the rectum was a retrograde implantation; and the question arose as to whether or not this was producing a compression of the lower left ureter. Because of the increase in number and severity of the renal colics, in view of the fact that attempts to dilate the stricture failed, and because the patient was slowly but surely losing ground, it was decided to operate upon him.

Operation November 16, 1919. At the suggestion of Dr. Herrick an exploratory laparotomy was done before the bladder was opened. A right rectus incision, 18 centimeters long, was made. On opening the peritoneum pale yellow fluid gushed through the opening. On exposing the liver, grayish, hard nodules, about 2½ centimeters in diameter, were seen on the anterior surface. The palpating hand could feel the liver studded with similar hard nodules. The stomach was delivered and carefully palpated but no pathology was discovered. Examination of the pancreas showed a hard,

nodular mass firmly fixed posteriorly. This mass involved the head of the pancreas and was as large as a small lemon. On exploring the pelvis a small mass was felt in the cul-de-sac. After exploration, the abdomen was closed with catgut and silk, and the wound sealed with collodion.

The bladder was exposed through the usual suprapubic incision. The peritoneum and prevesical fat were stripped from the bladder. The bladder was opened by an incision 4 inches long. The bladder mucosa was thrown into very coarse folds or wrinkles, which were dry, lusterless, and of a dark-slate to grayish-blue tint. Scattered on the surface were thin plaques varying in size from ½ to 1 centimeter. They were about ¼ centimeter thick and were elevated above the surface of the bladder. These plaques had a sharp, well-defined border. At the junction of the posterior and superior walls of the bladder along the apex was seen an area about the size of a dime. The surface of this was coarsely granular and the edges irregular. This was the only area of mucosa that was seen. Sections of the bladder mucosa, including the plaques, were removed for microscopic study. The left ureteral orifice was located and a small, filiform bougie passed up for a distance of 7 centimeters. This was followed by large filiforms and then a small ureteral catheter. The orifice was then slit with a scissors. Ureteral catheters up to and including a large No. 6 were passed into the kidney pelvis without difficulty or obstruction. A rubber drain was stitched to the bladder wall and the bladder closed with catgut. The abdominal wall was closed with catgut and silkworm-gut.

Postoperative course. Following operation the wound began to gap and around the edges there was seen a dark colored slough. The umbilicus, which at the time of operation showed a nodule, rapidly increased in size and became very red, so that at the end of 3 weeks it was as large as a nickel. The bladder fistula was kept open and daily irrigations continued.

On December 5, the patient developed a jaundice which persisted up to the time of his death. He failed rapidly, became pale and drowsy, and died on December 19, 1919.

The autopsy was performed by B. O. Raulston, pathologist at Presbyterian Hospital, whose report follows:

Anatomical diagnosis. Carcinoma of the pancreas with metastases in the liver, peritoneum, umbilicus, pleura, pericardium, lungs, peri-aortic and inguinal lymph glands, and each adrenal; right pyelonephritis; bilateral ureteropyelitis; left hydronephrosis; chronic cystitis, and acute membranous cystitis; fibrous stricture of the lower portion of the left ureter; leukoplakia of the entire urinary bladder and lower portion of the left ureter; emaciation and anæmia; ascites; icterus; recent suprapubic cystotomy wound—partially healed; recent surgical scar in the right upper abdominal wall; thrombosis of the veins in the pudendal plexus; multiple hæmorrhagic infarcts in the lungs; bilateral fibrinous pleuritis; extensive hæmorrhage into and beneath the parietal pleura; serous degeneration of subpericardial adipose tissue; moderate atheromatous changes of the aorta; decubital ulcer over the sacrum; patent right inguinal ring; small patent foramen ovale; healed calcified tracheobronchial lymphadenitis.

Left kidney. The left kidney is soft and fluctuates to some degree throughout. This fluctuation is most marked in the superior pole, where the kidney is almost of cystic consistency. Dark-brown fluid escapes when the kidney is sectioned. The pelvis of the kidney is greatly dilated, measuring from one pole on the open kidney to the other, 13 centimeters. The wall of the pelvis is greatly thickened and is markedly reddened.

Left ureter. The entire length of the left ureter is greatly dilated and when measured from cut edge to cut edge, the distance, immediately below the pelvis of the kidney, is 2 centimeters, at the middle portion 2.5 centimeters, and immediately above the junction with the bladder is 2.5 centimeters. Two centimeters above the junction of the ureter with the bladder, there are a number of oval-shaped regions where the lining of the ureter is light-gray to white in color, of dull luster, and markedly elevated. For a distance of 3 centimeters the lining of the ureter is replaced for the most part by this elevated pearl gray tissue (Fig. 1). The mucosa is very red.

Right kidney. When the right kidney is removed there can be seen beneath its capsule large regions that are pinkish-red in color, stippled with innumerable grayish to light yellow spots. When the kidney is sectioned there is found in the medulla and extending to the cortex, apparently along the tubules a yellowish-gray substance that resembles pus. The kidney substance is extremely soft and semipurulent, but no actual abscesses are found. The pelvis of the kidney is moderately dilated, as is its ureter.

Right ureter. This ureter is most dilated immediately above its junction with the urinary bladder, where it measures 2 centimeters across after it is opened.

The opening of each ureter in the urinary bladder is easily demonstrated and is not obstructed. In the wall of the left ureter, 5 millimeters above its junction with the walls of the urinary bladder, there is a *dense fibrous thickening.* Immediately above this there begins the peculiar deformity of the lining of this ureter described above.

Bladder. The lining of the urinary bladder is wrinkled and irregularly elevated, and the mucosa presents the same grayish appearance as that observed in the lower portion of the left ureter. A considerable portion of the urinary bladder is covered with gray membranous patches, which, when pulled away, bring the mucosa with them. This membranous material is covered on its surface by the smallest pinpoint-size, yellowish specks that

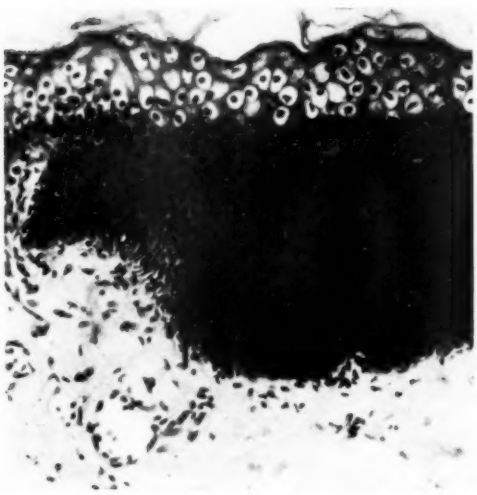

Fig. 3. An area of mucosa which shows the presence of large vacuolated cells.

Fig. 4. An area of mucosa which shows the presence of large vacuolated cells.

resemble deposits of urinary salts. In the fundus of the bladder, there is found an opening 2 centimeters long, which is continuous with the surgical wound in the lower portion of the abdomen.

Prostate. The prostate is of normal size and consistency. It does not obstruct the urethra.

Urethra. The entire penis was removed. The urethra was opened and showed a normal mucosa. Nowhere in the urethra was there any evidence of leukoplakia.

Examination of the pieces of tissue removed from the bladder at the time of operation showed the following:

Adhering to the surface of the mucosa are seen large collections of desquamated, squamous epithelial cells. In some of the areas the collections are very extensive and in the others very small, so that the mucosa is almost devoid of them. The most superficial of these appear to be loosely attached. Here and there can be seen collections of fresh red blood cells. This layer has been designated by some as stratum corneum. Below this stratum corneum can be seen a layer that is composed of many fine granules (stratum granulosum). It is believed these granules are composed of keratohyaline material.

Between the stratum granulosum and the stratum corneum is seen a stratum lucidum. Below the stratum granulosum is seen a layer varying in thickness. In this layer the cells are more or less regularly arranged. The epithelial cells next to the submucosa are placed at right angles to the free surface. These cells are columnar in shape.

In some of the sections, the mucosa is very thin and the cells appear as though compressed, as a result of which the cells are placed at a right angle to the previously mentioned columnar cells.

Papillæ, such as occur in the skin, are seen in some of the sections. Some of the sections show the presence of vacuolated cells. The submucosa shows only an occasional area of round-cell infiltration which is somewhat at variance with the reports found in the literature.

It was only due to the postmortem that we were able to state definitely that in this case the leukoplakia was present in the ureter as well as in the bladder, for without the autopsy findings this case might have passed for a simple case of leukoplakia of the bladder. Also it enabled us to state that the ureteral involvement was present on one side and that in this ureter only the lower 3 inches showed the presence of leukoplakia. This brings up the question as to whether the cases reported as leukoplakia of the bladder were really cases limited to the bladder, or whether changes had occurred in the ureter and kidney pelvis which could not be demonstrated clinically. The autopsy confirmed and verified the clinical diagnosis of stricture of the left ureter, and in view of the fact that the leukoplakia of the ureter was present on the same side, leads to the question of whether or not there was some causal relationship

between the two and whether or not the occurrence of both lesions was more or less coincident.

SYNONYMS

Various names have been used in describing this condition, such as metaplasia, xerosis, cholesteotoma, leukoplakia, leukoplasia, pachydermia, etc. And here it would be well to state that the pathological condition described in this paper, should not be confused with von Hansemann's malakoplakia, a case of which was reported by Folsom at the last meeting of the American Medical Association. These are two distinct pathological conditions. They differ both macroscopically and microscopically.

FREQUENCY

A review of the literature shows that 43 cases have been reported, which with the case I have just reported, brings the total number up to 44. Of this number, 5 were reported by American authors — namely, Beer (2 cases), Zipser, A. T. Cabot, and Kretschmer (1 each). It is possible that there may be more than 5 cases reported by American authors; however, I have not seen them in my perusal of the literature.

AGE

Age does not seem to be an essential etiologic factor, since cases have been reported at both extremes of life. The youngest case on record was reported by Leber and occurred in an infant 4 months old. Two cases were reported in individuals aged 71; one by Albarran and one by Hallé. Between these two extremes various ages are recorded.

Marchand's patient was 7 years old. Between the ages of 11 and 20, 3 cases were recorded; between the ages of 21 and 30, 9 cases. The largest number occurred between the ages of 31 and 40, in which decade there were 12 cases. Out of a total of 44 cases this makes about 25 per cent of cases occurring in this decade. Between 41 and 50 there were 3 cases; 51 and 60, 7 cases; 61 and 70, 6 cases; above 70, the 2 cases mentioned above. Seventeen cases occurred between the ages of 30 and 50, and if this is considered as middle life, it is apparent that about 33 per cent of the cases occurred between these ages.

SEX

There was a preponderance of males over females, 34 cases occurring in males, 8 in females, and the sex not stated in 2 cases. In Braatz's case the local pain manifested itself during pregnancy. In one of Hallé's cases the symptoms began after a difficult labor resulting in retention and catheterization for 3 days, after which time symptoms of cystitis were present. It is highly probable that pregnancy was an incident and not an etiologic factor.

PREVIOUS VENEREAL HISTORY

A positive history of gonorrhœal infection with one or more attacks was mentioned in 14 cases, and in some the symptoms dated from the time of onset of the gonorrhœa, such as the persistence of cloudy urine and bladder symptoms. Many cases, on the other hand, denied gonorrhœal infection, so that the rôle of gonorrhœa as an etiologic factor cannot be taken into consideration. It is quite possible that the leukoplakia may have been present before the patient acquired gonorrhœa and that this infection superimposed upon the leukoplakia may have stirred the latter into activity. Many cases denied ever having had gonorrhœa. This was the case in my patient. In some a positive history of syphilis was obtained. Evidently syphilis does not seem to play an important rôle, although Posadas thinks that some of these cases are on a syphilitic basis.

PATHOGENESIS

The etiology of this condition is still unknown. Various theories have been advanced, none of which seems to explain the occurrence of this condition in all the cases. The presence of calculi in the bladder in a number of these cases has led some to believe that stone may be a factor in the production of the condition, and yet stone is not always found in these cases. On the other hand, there are thousands of cases of bladder stone which have never shown the presence of leukoplakia. The presence of a foreign body,

namely, a calculus, has led some authors to believe that the presence of a stone or a foreign body produces irritation and that irritation in turn results in the production of leukoplakia. Attention has been called to the presence of similar plaques in the mouth. Leukoplakia is often met with in pipe smokers. It would seem reasonable to state that stone is merely an incidence.

Lecène does not feel satisfied that chronic inflammation is responsible for this condition. He thinks that the lesion is congenital, due to disturbances in the development of the urinary apparatus. He states that embryologically it is easy to explain heterotopia of the endodermic cells in the vicinity of the mucosa of the upper urinary passages and that the fact that such can occur is sufficient to account for the lesions of leukoplakia.

Hallé concludes that chronic inflammation, simple or calculous, can produce an epithelial transformation in the mucosa of the urinary tract. The normal covering is transformed into a stratified pavement epithelium with epidermic characteristics.

Hallé in reporting his cases states that study shows the in.'uence of chronic inflammation in the etiology of epithelial transformations. Almost always these patients show an old cystitis, or a ureteropyelitis and cystitis due to gonorrhœa, stricture, or prostatic disease, or a postpuerperal cystitis due to catheterization, especially in cases that have been tenacious and rebellious to treatment.

Lichtenstern mentioned as etiologic factors long-continued inflammation, foreign bodies, stones, tuberculosis, etc.

Posadas believes that leukoplakia, in most instances, offers a pathology the origin of which must be traced back to syphilis, when it evidently comes under the influence of specific treatment. If we do not obtain a satisfactory result with the usual methods of treatment in the presence of a decided vesical affection with febrile hæmaturia and the throwing off of purulent mucosa, we should try mercurial treatment before proceeding to do a suprapubic cystotomy.

That this disease may have a congenital origin has been mentioned; and in view of this fact the case of Leber has been repeatedly cited. Leber's case, it will be recalled, occurred in an infant, 4 months old, in whom besides the leukoplakia of the kidney there was also leukoplakia of the eye.

NUTRITION

A number of the patients were poorly nourished; hence, the idea occurred to some of the investigators that the weak, anæmic, run-down, and poorly nourished may be predisposed to the disease. This factor is especially emphasized by the authors who have written on leukoplakia occurring in the mucous membrane of the eye.

DISTRIBUTION

There are no hard and fast rules about the distribution of this process in the urinary tract. In some instances, the entire urinary tract is the seat of the disease. Hallé has reported 2 cases in which the entire upper urinary tract was involved; a similar condition obtained in Marchand's and Chiari's cases.

The amount of bladder involvement is variable. The number of cases in which the entire bladder mucosa was involved is small. In 2 of Escat's cases the entire bladder was involved. In the case reported in this paper the entire bladder was the seat of the leukoplakia with the exception of a small area, as large as a dime, at the apex. However, when the entire bladder is not involved, there does not seem to be any regular distribution of leukoplakia. The various reports show involvement of the trigone, anterior wall, fundus, neck, and lateral walls, as well as the posterior walls. Czerny's case is unique in that the leukoplakia was found in a diverticulum, the only case of its kind that I have been able to find.

ASSOCIATED PATHOLOGY

1. *Bladder.* In 3 of Hallé's cases calculi were found in the bladder, as well as in the cases of Cabot, Albarran, Nogués, and Verrière.

2. *Ureter.* An associated stricture of the ureter was found in one of Verrière's cases. This, with mine, makes a total of 2 cases in

which there was found at autopsy an associated stricture of the ureter.

3. *Kidney.* Various associated conditions have been found in the kidneys. In one of Beer's cases the kidney was converted into a pyonephrosis. There was a tuberculous destruction of the papillæ as well as tuberculous foci in the cortex. Lecène's case showed a large infected kidney with retention, so that at examination the kidney was as large as two fists and palpable in the lumbar region. One of Hallé's cases had a stone in the pelvis and Chiari's case showed a bilateral dilatation of the renal pelves and an indigo stone. One of Rona's cases showed a paranephritis and perinephritis with stones in the pelvis and ureter of the opposite kidney. His second case showed a purulent perinephritis with the presence of a carcinoma of the bladder. Beselin's patient showed renal and ureteral tuberculosis, and in Brik's case the kidney showed an associated interstitial nephritis. The case reported in this paper had a primary carcinoma of the pancreas.

4. *Eye.* Of great interest is the case Leber reported of the simultaneous occurrence of leukoplakia in the kidneys and in the eye. This is the youngest case so far reported and the only one that I know of where this combination is on record, namely, the simultaneous occurrence of leukoplakia in the kidneys and in the eye.

The one etiologic factor that is brought out by many of the authors is the fact that long-continued inflammation or irritation may play a rôle in the causation of this condition. Nevertheless, the possibility of long-continued irritation must be excluded from a well-defined case in an infant only four months old. Naturally, this case brings up the question of the possible congenital origin of the disease.

BACTERIOLOGY

Since many cases were reported before careful bacteriological study of the urine was a routine procedure, it is only natural to find that this part of the case reports is very scant. As a matter of fact, most of the articles do not mention anything about the type of organisms found. Where bacteriological reports are at hand, a great variety of organisms has been found. Thus, Zipser's findings were bacillus lactus aerogenes, bacillus proteus, staphylococcus albus, and a gram-positive bacillus. Lecène reported the presence of bacillus coli, and Herzen, the combination of streptococci, staphylococci, and bacillus coli. Lendorf states that cocci and bacilli were found, and Brik mentions the fact that bacteria were found. Beer found sterile urine in one of his cases. In the case reported in this paper the combination of staphylococci and bacillus coli was obtained upon culture.

SYMPTOMS

Subjective symptoms are not typical. There is no symptom-complex by means of which a positive diagnosis can be made from the symptoms alone. Often the history of onset dates back many years. In my own case the patient stated that his first symptoms began 15 years before coming in for examination. In Cabot's case, the patient had had his first symptoms following a lithotomy 20 years previously. A history of bladder trouble for 30 years was noted in Nogués' case. Apart from this group of cases in which the history of onset dated back many years, one finds the opposite; namely, a rather short duration of symptoms, as in Lecène's case, in which the symptoms had been present for only nine months. In Czerny's case there were no symptoms referable to this condition, and the finding was quite accidental, the patient having been operated upon for injury. At the time of operation a diverticulum of the bladder was found, which was removed and the leukoplakia was found in the diverticulum.

The symptoms as mentioned above may date back to a previous illness. Some of the patients stated that the urine had been cloudy since a previous attack of gonorrhœa; and in some the symptoms were manifested after an attack of retention of urine which required the use of the catheter, as in the cases of Cabot, Brik, Hallé, and the 2 cases of Nogués. In the case that is the subject of this paper the patient was very positive

about the onset of his illness after a severe cold which he had contracted 15 years before. Interesting in this connection, too, is the case of Zipser, in which the patient injected something into his bladder in order to escape military service in Russia.

Painful urination, associated with frequency, hæmaturia, and the presence of pus in the urine, is the most frequent symptom of which the patient complains. The degree of pain is usually very severe. *Cystitis dolorosa* is the term used by some of the authors in reporting their cases. The frequency may vary: in some of the cases the patients were obliged to void every 10 minutes. A degree of severity in the symptoms may be due to the presence of coexisting lesions, such as bladder calculi and lesions of the prostate.

The kidney cases complain of pain in the region of the kidney, and there are often repeated attacks of renal colic associated with nausea and vomiting. Beselin reports 200 attacks of renal colic.

PASSAGE OF EPITHELIAL CELLS

This symptom is important. The passage of large or small pieces of membrane has been noted, which may often be associated with attacks of renal colic. Many of the patients have noticed that the urine contained large or small flocculi or masses. In some of the reports, the patients stated that they had passed sand or gravel. It is well within the realm of possibility that the patients who thought they had passed calculi, in reality had passed small pieces of desquamated membrane. The presence of a large quantity of epithelial cells in the urine is a matter of record: a number of the patients gave a history of having passed a mass of epithelium in the urine for many years. My own case probably passed these epithelial masses for fifteen years, although he stated that he had passed calculi or gravel for 15 years. Hence, it seems more reasonable to conclude that what he thought was sand or gravel was really masses of epithelial cells and desquamated mucous membrane. Lendorf's patient passed masses of epithelial cells for 10 years. Masses of epithelial cells have been passed in the urine and so reported by Brik, Marchand, Herzen, Lohnstein, Cabot, and Beer. Beer's case is very instructive, bearing on the relationship of the passage of membrane and renal colic. Following pelvic lavage, the patient had an attack of renal colic, after which very large pieces of membrane were passed.

CYSTOSCOPIC FINDINGS

These are quite characteristic and the diagnosis can very easily be made from the cystoscopic picture. The presence of white or gray, pale, lusterless, irregular-shaped plaques which are surrounded by normal or inflamed and ulcerated mucous membrane is quite typical. Generally, these plaques do not show the presence of blood-vessels. In the cases of total bladder leukoplakia the entire vesical mucous membrane has a dull white or bluish-white appearance. One striking feature in the cystoscopic picture in my case was the fact that no blood-vessels were visible anywhere except in a small area at the apex. The entire mucous membrane was white, dull and without luster, and no blood-vessels were seen in the area of the leukoplakia. The two plaques found at operation were not noted at the time of the cystoscopic examination; this was due, no doubt, to the fact that they were situated in the area of the leukoplakia. Being of the same general appearance as the rest of the bladder, they did not stand out so prominently as the plaques do when they are surrounded by normal or inflamed mucous membrane.

TREATMENT

The treatment of this condition resolves itself into non-operative and operative.

A. Non-operative treatment. As a rule, this treatment, in the form of bladder irrigations and instillations, does not seem to influence the course of the disease very much, although improvement has been noted in some cases. Various drugs have been used for local treatment, such as silver nitrate, oxycyanide of mercury and resorcin. In leukoplakia of the renal pelvis, pelvic lavage has been resorted to. A cure has been reported with this form of treatment by Stockmann.

B. Operative treatment. This treatment must be directed, not only toward the leukoplakia, but toward the coexisting lesions as well. The presence of calculi calls for their removal. Litholapaxy was the method used by Nogués, Hallé and Verrière. The stones were often removed by suprapubic cystotomy, so that treatment could be directed toward the leukoplakia. Where isolated plaques were found, good results have been reported after excision of the plaques. Besides excision of the plaques, the plaques have been curetted and cauterized. In females the curettage has been done *per urethram.*

Simple suprapubic drainage has been advised. This was carried out in my patient, since resection was out of the question, due to the extent of the pathological process. In the kidney cases nephrectomy was not done for the leukoplakia particularly: the operation was directed toward some other condition and the leukoplakia was found as an associated condition.

CASE REPORTS

The following cases were found in the literature available. The histories and findings have been condensed. Posadas' case is not included, not being accessible.

ALBARRAN'S CASES

CASE 1. Female, age 30, was confined 11 years before consulting author. Following delivery she had retention of urine for 3 days. From that time on—hæmorrhages, cystitis, and tenesmus. The urine showed the presence of blood, pus, and pavement epithelium. No tubercle bacilli were found. Curettage of the trigone through the urethra was performed.

CASE 2. Female, age 30, had suffered with cystitis for 2 years, accompanied by the presence of blood and pus in the urine. Cystoscopy showed the presence of hard, thick, white plaques to the right of the bladder neck and one isolated plaque on the lateral wall. Suprapubic cystotomy and curettage resulted in cure.

CASE 3. Male, age 62, died of lobar pneumonia. He had suffered from blennorrhœa for 20 years. For the last 12 years of his life he had bladder trouble with the occasional presence of blood in the urine, cystitis dolorosa, calculus vesicæ, renal colic, and suppurative orchitis. The urine contained necrotic shreds, but no sugar. Pus and many epidermal cells were found in the sediment. No operation was performed.

Postmortem findings. The bladder was thickened, with trabeculæ and cellules. The ureters were thickened and dilated. Pus was found in the urine. The kidneys were atrophied and contained miliary abscesses.

Microscopic report. Derma and submucosa were firm, infiltrated and vascularized. The papillæ were rudimentary. The epithelium was thickened. Two patches at the neck of the bladder consisted of two strata, one containing three or four layers of cuboid cells with large granules, and the other, a thick, horny layer, consisting of pavement cells, but no granular layer. Between the two layers, polygonal small cells, not dentated, were found. In the ulcerated places the epithelium was changed and partly missing. The derma was inflamed.

CASE 4. Male, age 71, was brought to the hospital in a state of coma, dying of bronchopneumonia.

Postmortem findings. The patient had suffered for a long time with bladder trouble due to stone in the bladder; strangury every 10 minutes. The bladder was thickened. The mucous membrane over the whole bladder was dull white, hard, and partly warty. The entire epithelium and derma were thickened. The papillæ were rudimentary. The submucosa was firmly adherent and there were no signs of inflammation. The epithelium consisted of two layers of cuboid cells with large granules; the pavement cells were thin. On the surface were horny, scale-like cells. At the sites of the leukoplakia the epithelium was thick, consisting of many cylindrical cells, dentated, thin, clear, easily fused cells, and over it a hyaline, horny layer. The eleidin layer was absent.

BEER'S CASES

CASE 1. Male, age 20. At the age of 17 had had an attack of cystitis which was quite rebellious. Tests for tuberculosis were negative. He had pronounced pain and tenderness in the left lumbar region. X-ray examination for calculus was negative. Two years later he had had a sudden attack of left renal colic. Examination showed tenderness along the left ureter and over the left kidney.

Examination of the urine showed it to be normal in color, but floating around in it were pearly white membranes, which looked like paraffin scrapings. Adherent to the scrapings were granulations. Closer examination revealed that the pearly white appearance was limited to one side only, the other side not being so white. To this side some granulations were adherent. These plates and other similar granulations found in the sediment responded to none of the tests for phosphates, oxalates, urates, cystins or xanthins, and were, without doubt, silicates.

Cystoscopic examination showed normally placed ureters. The left ureter was swollen. The bladder was negative, showing no signs of leukoplakia. The specimen obtained from the catheter showed many epithelial cells, pus, and red blood cells. Both specimens were sterile.

Following catheterization the patient developed colic and a large piece of membrane was found in the urine.

CASE 2. Male, age 35, had been sick for 9 months with pain in the left flank, radiating to scrotum. The pain was dull in character. There was some increased frequency of urination, associated with pain and occasional hæmaturia. The kidney was twice as large as normal and converted into a pyelonephrosis. Nephrectomy was performed. There was a tuberculous destruction of the papillæ as well as tuberculous foci in the cortex. In the lower half of the pelvis there was a large area of leukoplakia about the size of a dollar.

BESELIN'S CASE

Male, age 35, who denied previous venereal disease, had had attacks of pain in the right side, evidently renal colic, at the ages of 18 and 20 years. Similar attacks of pain with vomiting and an uncomfortable feeling in the bladder at 30. Urine showed the presence of white plaques, consisting of squamous epithelium and plates of

cholesterin, red blood cells and pus cells. The patient had about 200 attacks of pain. Nephrectomy was performed for tuberculous pyelonephritis, following which the patient died of hæmorrhage.

Autopsy. Chronic cystitis; the pelvis of the kidney was dilated and the papillæ somewhat flattened. The mucous membrane of the pelvis and calyx was covered with membrane, white in color and with a mother-of-pearl appearance. There was tuberculosis of the right kidney and right ureter.

Diagnosis. Cholesteatoma of the renal pelvis.

BRAATZ'S CASE

Female, age 33, large, well-built. Pain was present in the region of the right kidney for a long time, which became worse during pregnancy. She had had attacks of renal colic due to passage of large amounts of desquamated epithelium. Bladder symptoms for 2 years. Had had repeated attacks of chills, fever, and vomiting. The urine contained pus.

A right nephrectomy was performed. The mucous membrane of the pelvis had the appearance of epidermis. There was found an associated interstitial nephritis.

BRIK'S CASES

CASE 1. Male, age 37, had had gonorrhœal infection 15 years previous to consulting author. He had had bladder catarrh with terminal hæmorrhages, for which he had received internal treatment without relief. Frequency was marked, patient voiding every 20 minutes. The urine was cloudy and alkaline. Examination showed leucocytes, bladder epithelium, and bacteria. Daily irrigations with 2 per cent resorcin solution were instituted.

Cystoscopy showed the presence of areas of white color in the region of the fundus of the bladder. Repeated examination showed a slow but steady increase of the plaques. Clearing up of the plaques did not take place in spite of special treatment for them.

CASE 2. Male, age 59, had had several attacks of gonorrhœa; last attack in 1893. In 1894 he had retention of urine, requiring catheterization. The symptoms continued to increase. Frequency was marked—every 10 minutes. The urine was cloudy, acid in reaction, and contained red blood cells, leucocytes, hyaline casts, and epithelial cells. He was treated with instillations of silver nitrate.

Cystoscopy showed marked injection of the bladder mucous membrane. Upon the trigone and around the bladder neck were tassel-shaped masses.

Suprapubic cystotomy was performed, with removal of areas of proliferation and plaques. Patient died on the third day.

The author considers this a case of leukoplakia because the histological specimen showed proliferation of epithelium.

CASE 3. Male, age 41. Twenty-three years before consulting author, patient had had gonorrhœa complicated by cystitis; subsequent attacks of gonorrhœa 19 and 16 years previously. The urine was bloody. Prostate and urethra were normal; bladder-wall was thick. Bladder capacity limited to 50 cubic centimeters. The urine showed the presence of red blood cells and many large pavement epithelial cells and bacteria, and triple phosphates.

Cystoscopy revealed plaques on the posterior wall. Local treatment produced no result.

A. T. CABOT'S CASE

Male, age 40. In 1870 he was operated on for stone, by lateral perineal method. The wound healed in 3 weeks. Frequency persisted after operation. Five years before consulting Cabot, he had had an acute attack of cystitis with pain. The patient stated that he never wholly recovered from this attack. Later, he had had an attack of retention of urine requiring catheterization, after which he had passed a small phosphatic stone. Occasionally he passed a few drops of blood at the end of urination. The urine was loaded with mucus and pus, and contained many pavement epithelial cells, single and in clumps.

Suprapubic cystotomy was performed. On opening the bladder the posterior wall was seen to be yellowish-white in color and soft to the examining finger. It was found that the thick membrane could be pulled in shreds from its surface with the finger. After its removal, it left a smooth surface which bled but slightly. The wound closed and the patient passed urine the natural way.

After the operation the frequency persisted and the urine showed albumin, pus, and blood. This condition improved under irrigations of silver nitrate. At the time of his discharge from the hospital there was still a large amount of sediment, consisting chiefly of mucus and epithelial flakes. Irrigations of boric solution and silver nitrate were used. The patient was observed some time later and continued well. The last time Cabot saw him the urine contained no epithelial clumps. It was still cloudy, due to mucus.

CHIARI'S CASE

Female, age 34, suffered from kidney stone and pyelitis with purulent cystitis. Both renal pelves dilated; an indigo stone was present. The mucous membrane of the pelvis was thick, white in color, and had an epidermis-like appearance. The ureter showed similar changes, as did also the bladder.

CZERNY'S CASE

Male, age 20. The patient had fallen from a roof, following which he had difficult urination and retention of urine, but no hæmaturia. The bladder extended about a hand's breadth over the symphysis. After catheterization a swelling remained. Pressure upon this swelling was followed by a discharge of urine. A diagnosis of diverticulum of the bladder was made.

A suprapubic cystotomy was performed and the diverticulum was explored. The diverticulum was about the size of a small fist. Its wall was thickened and the mucous membrane had an epidermis-like appearance. The lining consisted of many œdematous sloughs and pavement epithelial cells.

EBSTEIN'S CASE

Male, age 20, died of uræmia following chronic ureteritis. *Autopsy.* In the ureter were found slightly elevated plaques and a thickening of the epithelium.

ESCAT'S CASES

CASE 1. Male, age 22. For 4 years the patient had suffered from hæmaturia. The bladder was contracted. A suprapubic cystotomy was performed, followed by recovery. On the bladder wall was seen hyaline degeneration. In the left half of the bladder the mucous membrane of the base and neck was very hard. From the bladder were seen protruding nodular masses. At the neck of the bladder was a mass of epithelium (papilloma).

CASE 2. Male, age 39, had suffered with bladder distress for one and a half years. The urine was turbid, foul-smelling, and ammoniacal. It contained whitish masses and partly necrotic shreds that were swimming around on top like wax.

A suprapubic cystotomy was performed. On opening the bladder there gushed forth from the wound masses resembling smegma. The entire bladder was filled with these masses. The masses and thickened area of the bladder were about 3 millimeters thick. The mucous membrane was swollen but not ulcerated. After scraping off the masses, the membrane was reddened and infiltrated.

Cystoscopic examination previous to operation showed white elevated plaques. The masses in the urine consisted of pavement epithelium with many microbes.

HALLÉ'S CASES

CASE 1. Male, age 39. Incontinence of urine at the age of 4 and well-marked cystitis at 22, at which time he had had frequency of urination, painful urination, and terminal hæmaturia. Bladder trouble from that time on. For 5 years before consulting author, he had had attacks of renal colic, accompanied by the passage of small white sand grains. For a year the symptoms of cystitis had been very marked.

Examination showed the urine mixed with blood and pus. The bladder was painful on palpation. The left lobe of the prostate was enlarged. The left kidney was painful on palpation. He was treated with silver nitrate instillations and improved temporarily.

He returned to the hospital a few months later. The bladder was curetted through a perineal opening and the urethra dilated. The patient gradually weakened and died.

Autopsy. The bladder wall was thickened. The fundus and the greater part of the posterior wall were covered with extensive single plaques of white-gray-greenish color with clear-cut edges. The rest of the mucosa was without ulceration. The right ureter showed typical leukoplakia in its entire length. The right kidney pelvis was dilated and showed leukoplakia. The left ureter contained a similar lesion to that found in the right ureter. The left pelvis was thickened and adherent.

CASE 2. Male, age 65. He had had two attacks of gonorrhœa without complications, at the ages of 25 and 35; difficult urination for 11 years. Eight years previous to consulting author, he had had hæmaturia, which lasted 11 days; difficult urination at night. A diagnosis of calculus was made, and the calculus was removed by litholapaxy. This operation was repeated twice in the course of the next few years.

At the time of admission to the hospital a calculus was present in the bladder. The urine was foul, purulent, and bloody. His general condition was poor. A suprapubic cystotomy was performed and the calculus removed. The patient died 4 days after operation.

Autopsy. The bladder was thickened and showed the presence of gray-green colored, clear-edged, and slightly projecting plaques.

CASE 3. Male, age 70, who gave a history of gonorrhœa and incontinence of urine 25 years previously. He had had stricture 20 years previously, followed by bladder trouble: voided urine containing blood, pus, and soft gravel. Later he had had an attack of retention of urine, requiring catheterization.

The bladder was painful and a large calculus could be felt in the bladder. This was removed by litholapaxy. He left the hospital in good condition.

Eighteen months later he re-entered the hospital with painful urination and purulent urine. He died 15 days after admission.

Autopsy. The condition of the bladder indicated chronic cystitis and thickened walls. In the lower segment were multiple plaques; in the upper a much smaller number. The plaques in the lower segment were small and circumscribed. Both ureters and both kidneys showed similar lesions.

CASE 4. Male, age 71, entered hospital in a comatose condition. Only a scant history was obtainable. He had had frequency of urination for a long time—every 10 minutes. Patient died of bronchopneumonia.

Autopsy. The bladder wall was thicker than normal; hard and cretaceous at the fold. A large, oval calculus was found. The ureters were healthy. The kidneys showed interstitial nephritis without pyelitis. The vesical mucosa in all its extent had undergone epidermic transformation. The walls were thickened.

CASE 5. Male, age 62. Had had an attack of gonorrhœa at 25. Sixteen years before consulting Hallé, had had cystitis, characterized by pain, frequency and blood, and accompanied by suppurative orchitis, followed by disturbed micturition which necessitated frequently the use of a catheter.

Upon admission to the hospital patient had to be catheterized seven or eight times daily. The urine was purulent. A calculus could be felt in the bladder. This was removed by litholapaxy.

Patient returned to hospital after a few months with the same symptoms and also symptoms of pulmonary congestion. He died 2 days after admission.

Autopsy. The prostate was hypertrophied. A phosphatic calculus was found in the bladder. The bladder walls were thick and the mucosa showed one plaque near the neck and another in the neck.

CASE 6. Female, age 30. Eleven years before consulting Hallé, had had retention of urine following a difficult labor. The catheter had been used for 3 days. Following this attack she had had cystitis of varying degree; purulent urine and hæmaturia, especially during the first 3 years. Patient voided sixty times in 24 hours and micturition was very painful.

Vesical curettage *per urethram* was performed. Histological examination showed a small membranous fragment containing a plaque about 1 centimeter square.

A suprapubic cystotomy was then performed. The bladder wall was thickened and the mucosa along the left ureteral orifice was red and ulcerated. A thick, large ulcer was found near the trigone.

Microscopic examination of fragments taken from these places showed vascularized derma.

The author thought that although the lesions were slight, the case was interesting, because it showed that the epithelium in this bladder, which had been the seat of a chronic inflammation for a long time, was in the course of proliferation and leukoplakic change.

CASE 7. Female, age 40, came to the hospital 4 years before this case was reported, with a bad cystitis. She had frequent and painful urination, purulent and bloody urine. On cystoscopic examination a plaque was seen on the right lateral part of bladder neck. This confirmed the diagnosis.

Suprapubic cystotomy was performed. At the anterior and right lateral parts of the bladder wall there was a necrotic patch, irregular in surface, thick, and hard. The mucosa in the vicinity of the trigone was red and inflamed. The plaque was removed by a curette. Recovery was easy, although frequency of urination and slightly purulent urine persisted. She was completely well at the time of reporting the case.

The scrapings from the currettage were not examined, but the author was of the opinion that it was a case of cystitis with limited leukoplakia.

CASE 8. Male, age 33. At 19 he had had gonorrhœa with bilateral orchitis, and later cystitis and blood in the urine. Pain in the kidneys for 18 months; also a stricture of the urethra, for which a urethrotomy was done.

Autopsy. Anatomic diagnosis: Tuberculosis of Cowper's glands, tuberculosis of the bladder, tuberculous ulcerations in right renal pelvis, calyces and pyramids; kidney tuberculosis, and tuberculosis of the lungs.

The middle third of the right ureter showed several white plaques with sharp borders, the plaques elevated and of an epidermis-like appearance.

CASE 9. The same author also reports a case that was operated on for calculous pyelonephritis. A large stone, made up of smaller stones, was found in the pelvis. The mucous membrane of the pelvis, where the stone lay, was thick, white, and had a hard, irregular surface.

HERZEN'S CASE

Male, age 21. At 18 he had had an attack of acute febrile disease accompanied by paralysis of the left lower extremity. There was noted an itching of the urethra and the urine was cloudy. To this were added, after a time, frequency and pain after urination. Pain in the left lumbar region for 2 years. The frequency and pain were increased by the use of tobacco and alcoholics.

Examination of the urine showed the presence of streptococci, staphylococci, and bacillus coli. No tubercle bacilli or gonococci were found. Internal treatment of bladder and irrigations did not improve the condition.

Examination. The patient was pale and thin, with a long thorax. Heart and lungs were negative.

The bladder was irrigated with oxycyanide of mercury, 1:5000. After bladder irrigation the urine contained many leucocytes, single flat epithelial cells with round shrivelled nuclei, arranged in rows, also many diplostreptococci and bacilli coli.

Cystoscopy. In the left half of the bladder the superficial layer of mucosa had a whitish-gray color. It was smooth throughout, except in some places where small roughenings were found. No blood vessels were seen in these areas. The edges were irregular and sharply defined by a red border. The altered region began at the crest of the left ureter and ran in wide strips to the left, posteriorly, and ended at the fundus of the bladder. The trigone and ureter were free. On ureteral catheterization clear urine was obtained.

A suprapubic cystotomy was performed (January 5) and a plaque was excised with a knife. On June 4, the wound was completely healed. Repeated examinations of the urine showed no epithelial cells or plaques. The patient was discharged June 7, at which time his general health was good and all local trouble had disappeared.

KREBS' CASE

Male, age not stated. He had complained of peculiar sensations in the bladder for 2 years when the bladder was full; hence, he voided before the bladder was really full or before he had a desire. The urine was turbid and contained leucocytes, bacteria, and epithelial cells. Gonorrhœa was admitted, but syphilis denied.

Cystoscopy showed a generalized cystitis. On the upper anterior surface of the bladder was seen a round, white plaque, the size of a silver rouble.

Internal treatment was administered. The pus and bacteria disappeared from the urine, but the urine remained turbid due to large amounts of squamous cells.

LEBER'S CASE

Female, age 4 months. *Autopsy.* The renal papillæ and calyces showed a definite thickening of the epithelium. The surface was covered with many layers of cells showing cornification. Small, thin plates were seen in the eye.

LECÈNE'S CASE

Female, age 28, entered the hospital because of pains in the region of right kidney. Nine months after labor at term, she had felt a dull pain in the right iliac fossa and lumbar region on the same side. Frequency of urination was present. The urine showed pus and albumin, but no blood. The kidney pains persisted and treatment was ineffectual. Palpation showed a tumor in the right lumbar fossa, the size of two fists, and sensitive on pressure. Roentgen-ray examination was negative.

Catheterization of right ureter showed the right kidney excreted only a little urea and chloride, while the left was normal.

Right nephrectomy was performed. The kidney pelvis looked distended and, for its greater part, seemed transformed into a thin cutaneous covering comparable with a slightly macerated lining of the prepuce or labia minora. This condition involved only a part of the mucosa. The mucosa was preserved in the upper part. The split ureter showed an inflamed mucosa. Infection was due to bacillus coli.

LENDORF'S CASE

Male, age 66, affected with syphilis at the age of 30; treated with inunctions. At the age of 30 he had had gonorrhœa which was complicated with cystitis. Later the urine was often cloudy. Had had attacks of frequency of urination. At the age of 56 he had had an apoplectic stroke, which had left a paralysis of the left nether (lower) extremity. For 3 or 4 years he had had frequency of urination at night and difficulty in emptying the bladder. Frequency of urination accompanied by pain in the bladder began 2 months before patient consulted Lendorf. He had to urinate ten to twelve times during the night.

Examination. The patient was slim but not emaciated. There were no signs of tabes. The prostate was somewhat enlarged. There were 140 cubic centimeters of residual urine. The urine was cloudy and had a very bad odor; it appeared as though it contained a pus-like sediment, as well as soft clumps of shreds which resembled cholesteatomatous masses. These masses were discovered at the time of irrigating the bladder. The patient, when shown these masses, stated that he had often passed them during the past 10 years.

Microscopic examination of the urine showed a few pus cells, many red blood cells, triple phosphate crystals, many cocci and bacteria. Cystoscopy showed the presence of flocculi which resembled leukoplakia linguæ. Catheterization of the ureters showed the kidneys free of disease.

The patient was treated from January until April, at the end of which time he was very much improved. No operation was performed. At the time of discharge he still continued to pass small clumps, as previously mentioned.

LICHTENSTERN'S CASE

Male, age 22, a Hebrew, who denied ever having had gonorrhœa and syphilis. The patient had had several attacks of frequency of urination accompanied by pain, at which time the urine was red and cloudy. When the patient consulted Lichtenstern he had a great deal of pain during micturition and the urine was very cloudy and dark red. He urinated every half-hour.

Examination of the heart, lungs, abdomen, thorax, and external genitalia was negative. The urethra was soft and not tender. The prostate was normal in size.

Examination of the urine showed albumin and sugar negative. The sediment contained many epithelial cells; no tubercle bacilli were present.

Cystoscopy. The trigone showed smooth areas of blue-gray color, sharply distorted. The mucosa was red and ulcerated.

Operation. The left ureter was small; the right flat. The ulcerated areas were removed with a scalpel. Tincture of iodine was applied and the areas of thickened mucous membrane were removed.

Following the operation irrigations of sublimate were given. When the patient left the hospital the urine was normal. Cystoscopic examination showed the presence of large, white, shiny plaques, sharply differentiated from the red, intact mucous membrane.

LOHNSTEIN'S CASE

Male, age 56, slim but healthy. Gonorrhœa at the age of 30, complicated with retention of urine; syphilis at age of 48. Had been treated with bougies for long periods. Urinated every 10 minutes. Pain was present both at the beginning and end of urination.

Cystoscopy. Trabeculæ were seen and several diverticula were noted. The trigone showed the presence of white spots. Some protrusion of the prostate was noted. A Bottini operation was performed with some improvement. After operation the patient passed large plaques of epithelial cells.

MARCHAND'S CASE

Male, age 7, entered the hospital with a diagnosis of cystitis. He returned to the hospital one and a half years later with apparently a vesicorectal fistula resulting from a perineal operation, alkaline urine, and cystitis. He re-entered the hospital a third time 4 years later with a generalized cystitis, purulent urine, and blood cells in urine. He died of cachexia and uræmia.

Autopsy. The lesions found confirmed the following diagnosis: calculous pyelonephritis; old urethral fistula; extensive leukoplakia of mucosa of urinary tract; cholesteatoma at inferior surface of diaphragm; limited tuberculosis of both lungs.

NOGUÉ'S CASES

CASE 1. Male, age 60. Disturbed urination for 30 years, cystitis, and retention necessitating catheterization for periods within the past 8 years. Had had a bladder infection 6 years before consulting author. This had recurred frequently.

Histological examination of the urinary sediment showed a considerable quantity of epithelial cells. It was a matter of detachment of the superficial face of the bladder under the influence of the medication employed for lavage. On suppressing the nitrate of silver lavage solution, considerable improvement was noted even after 48 hours. Later on, the same fact was noted to recur several times but not with the same intensity.

CASE 2. Male, age 59, complained of urinary disturbances and hæmaturia. Symptoms of urinary calculus for 2 years. The urine was much disturbed but as he had had gonorrhœa some months before, the cloudy urine was credited to it.

Histological examination showed that the urine was not disturbed, owing either to microbes or to suppuration, but only by epithelial cells from the superficial layer of the bladder. Later on, a very hard uric acid calculus was removed by lithotrity.

Case 1 shows the effects of silver nitrate on the bladder and Case 2 shows that a calculus may have an aseptic evolution.

RAVASINI'S CASES

CASE 1. Man, age 67, complained of pain in lower abdomen with bladder distress, for 1 year. Prostate was enlarged. Urine was turbid and contained blood and pus. The urine from the ureters was clear.

Cystoscopic examination showed white plaques.

Suprapubic cystotomy was performed. The plaques were removed by means of a currette; the prostate also removed.

CASE 2. Male, age 50, suffered for a long time with bladder trouble. The cystoscopic diagnosis was an infiltrating tumor of the bladder. Suprapubic cystotomy was done as a palliative measure. On opening the bladder a total leukoplakia of the organ was found. The patient died after 20 days.

Autopsy. Microscopically there was a transformation of the urinary epithelium into epidermic epithelium; papillary derma; dense, compact submucosa; muscular hypertrophy, partially sclerous with areas of embryonal infiltration; and also considerable dilatation of the vessels.

RONA'S CASES

CASE 1. Male, age 35. *Autopsy.* Clinical diagnosis was chronic pyelonephritis. The left kidney was medium in size and the capsule was fibrous. The calyces were about the size of a nut and covered with red-brown granulations. The kidney pelvis was the size of a pigeon's egg and covered with pale red mucous membrane. Two-thirds of the pelvis was covered with thick, white pavement epithelium. This led up to the mucous membrane of the ureter, which was 3½ centimeters thick. The right kidney was larger than the left. The capsule was thickened and when removed showed an extension of pus from the upper posterior part. There was some pus between the liver and diaphragm. The pelvis was greatly distended with pus and contained a stone. The ureters showed a mucous membrane slough as large as one's little finger and brownish-red in color. At the junction of the ureter and bladder was seen a stone, the size of a hazelnut. The mucous membrane of the bladder was injected and red.

Anatomic diagnosis was paranephritis and perinephritis; kidney stone in pelvis of kidney; stone in right ureter; chronic cystitis; and mucous xerosis of renal pelvis and left ureter.

CASE 2. Male, age 46. Clinical diagnosis: pulmonary and genito-urinary tuberculosis. Anatomic diagnosis: Purulent pyelonephritis, diphtheritic cystitis extending to the muscularis; ureteral dilatation with chronic ureteritis; xerosis of right kidney pelvis; and carcinoma of the bladder. There was no xerosis of the ureter.

STOCKMANN'S CASE

Female, age not stated, with acute onset of symptoms of cystitis. The patient was treated with rest in bed, internal treatment, and bladder irrigations. The patient passed pieces of membrane. The pieces of tissue that were passed were examined and a diagnosis of leukoplakia was made.

Cystoscopic examination showed the bladder to be normal and the left ureteral orifice normal. The right ureter was dilated. The urine on the right side was turbid and a diagnosis of right-sided pyelitis was made.

The author believes the membrane came from the pelvis of the kidney. The patient was treated by pelvic lavage with silver nitrate. Twenty-six treatments with 1 per

cent silver nitrate were given. Subsequent examination showed normal urine.

VERRIÈRE'S CASES

CASE 1. Male, age 58. He had had gonorrhœa complicated with hæmorrhagic cystitis at the age of 19. After that the bladder was somewhat sensitive. At the age of 53, micturition became difficult and painful, and a urethrotomy was performed. The urine was purulent.

Suprapubic operation was performed. A white plaque the size of a quarter was seen on the anterior surface. It was easily excised and the surface of the bladder cauterized. This plaque was similar to a leukoplakia plaque. There was a small nodule on the mucosa near the angle of the urethral orifice.

At the time of reporting the case, part of the urine still flowed through the fistula, which had not completely closed. Recovery was not absolutely satisfactory.

CASE 2. Male, age 59. He had had gonorrhœa at 18. At 49 he had experienced sharp pains at the point of the penis. Micturition was painful and frequent. Hæmaturia was noted soon after. Following these attacks a diagnosis was made of calculus, which was removed by litholapaxy.

The patient re-entered the hospital and was on medical management with some improvement. Two years later he again returned to the hospital, complaining of pain in the right kidney. The urine showed much sediment. Calculus in the bladder was diagnosed. The patient was operated on and died before the operation was concluded.

The autopsy showed the bladder diminished in capacity, with slightly thickened walls. There were two large leukokeratosed plaques, one near the neck of the bladder and the other near the fundus. The ureters were dilated and the left one strictured.

ZIPSER'S CASE

Male, age 33, tailor by occupation. He denied having had gonorrhœa and syphilis. The bladder trouble began at the age of 23, following the injection of foreign material; urinated every 2 hours, accompanied by pain and burning. Hæmaturia at the age of 25. For 7 years he had had frequent chills with cloudy urine and pain in the loin. For 10 months before consulting the author he had urinated every hour, the frequency being accompanied by severe burning at the tip of the penis and by hæmaturia. Prostate and vesicles were slightly enlarged.

Cystoscopy. The mucous membrane of the bladder indicated much thickening and was covered with a thick exudate, especially at the trigone. The right ureter was patulous.

Culture of the urine showed bacillus lactus aerogenes, bacillus proteus, staphylococcus albus, and two unidentified gram-positive bacilli.

Suprapubic cystotomy. At the trigone was seen an area of irregular epidermization. The area of leukoplakia was pearly white and was situated at the trigone near the right ureter. It was irregular in contour and resembled lingua geographica.

SUMMARY.

1. As far as a review of the present literature shows, the conclusion seems justified that leukoplakia is a rare condition.

2. The etiology is unknown.

3. The histopathological findings appear to be uniform and constant.

4. There is no symptom or symptom-complex by means of which the condition can be diagnosed.

5. The presence of large quantities of squamous epithelial cells in the urine from the bladder, or from the kidney after ureteral catheterization, and the passage of pieces of membrane or flakes of squamous epithelial cells, are very valuable findings in making the diagnosis.

6. By means of careful cystoscopic examination leukoplakia of the bladder can definitely be recognized.

BIBLIOGRAPHY

ALBARRAN. Les tumeurs de la vessie. Paris, 1892, p. 132. Quoted by Englisch, Ztschr. f. Urol., 1907. 1, 745.
BEER, EDWIN. Am. J. M. Sc., 1914, cxlvii, 244.
BESELIN, O. Arch. f. path. Anat., etc., Berl., 1885, xcix, 289.
BRAATZ. Deutsche Ztschr. f. Chir., 1898, iv, 72.
BRIK, J. H. Wien. med. Presse, 1896, p. 1129.
CABOT, A. T. Am. J. M. Sc., 1891, ci, 135.
CHIARI. Prag. med. Wchnschr., 1888, No. 50, 541.
CZERNY. Beitr. z. klin. Chir., 1897, xix 247.
EBSTEIN, H. Quoted by Englisch, Ztschr. f. Urol., 1907, 1, 745.
ENGLISCH, J. Ztschr. f. Urol., 1907, 1, 745.
ESCAT, J. Ann. d. mal. d. voies gén.-urin., 1900, xviii, 825-6. Also Intern. med. Congress, 1900, sect. Chir., Aug. 4.
HALLÉ, N. Ann. des. mal. d. voies. gén.-urin., 1896, xiv, 481-530; 577-623.
HERZEN. Deutsch. med. Wchnschr., 1910, xxvi, 1325.
KREBS, M. L. Petersburger med. Wchnschr., 1902, p. 42 (Beilage No. 7); also Zentralbl. f. Krankh. der Harn- u. Sexualorg., xiii, 629.
LEBER, TH. J. f. Ophthalmol., 1883, xxix, 242.
LECÈNE, P. J. d'urol., 1913, iii, 129-137.
LENDORF, A. Hospitalstidende, 1913, vi, 887-897.
LICHTENSTERN, R. Wien. klin. Wchnschr., 1904, xvii, No. 13.
LOHNSTEIN, H. Monatschr. f. Urol., 1898, iii, 65.
LOWENSON. Quoted by Englisch. Ztschr. f. Urol., 1907, i, 745.
MARCHAND. Quoted by Englisch, *ibid.*
NOGUÉS, P. Ann. d. mal. d. voies gén.-urin., 1899, xvii, 585-589.
POSADAS, J. Argentina medica, 1905, Jan. 21; abstracted in Ann. des mal. d. voies gén.-urin., 1906, xxiv, 58.
RAVASINI, C. Ann. d. mal. d. voies gén.-urin., 1902, xix, 1367-1368.
RONA, D. Monatsber. f. Urol., 1901, p. 705.
STOCKMANN, F. Zentralbl. f. Krankh. der Harn- u. Sexualorg., 1902, xiii, 621.
VERRIÈRE, A. Ann. d. mal. d. voies gén.-urin., 1901. p. 1385.
ZIPSER, J. E. Am. J. Urol., 1912, September, p. 487.

THE DIAGNOSIS AND TREATMENT OF HYDROCEPHALUS RESULTING FROM STRICTURES OF THE AQUEDUCT OF SYLVIUS

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THE purpose of this paper is to describe a type of hydrocephalus which occurs most frequently in infants, to give its pathology both gross and microscopical, to present the methods of diagnosis, and particularly to suggest a new form of treatment for this condition. To separate hydrocephalus into types is becoming increasingly difficult and, as our knowledge of this disease, but recently regarded as idiopathic, becomes better established, we are concerned less with subdividing it into groups and more with isolating the character and the exact location of the lesion which is causing the condition. Indeed, as the anatomy of the cerebrospinal spaces and the circulation of the cerebrospinal fluid become more clearly understood, hydrocephalus begins to appear as a single disease with varied anatomical manifestations, which are dependent upon the location of the underlying cause.

Hydrocephalus is always secondary to a primary cause and it should now be possible in every instance to locate the primary lesion, though its discovery, while at times simple, is usually sufficiently difficult to exhaust all the newer methods at our command. Moreover, in the chronic form of the disease (which is practically always referred to), there is but slight hope of spontaneous cure; there is no hope whatever from any medicinal therapy; the only hope lies in surgically correcting the cause of the disease, which is almost always an obstruction in the cerebrospinal spaces. The maximum results of surgical treatment, when this becomes proficient, and it is rapidly becoming so, will always be dependent on an early and accurate diagnosis.

The cases which comprise the particular group referred to in this paper are due to stenosis of the aqueduct of Sylvius. The vast majority of these cases begins in the prenatal period. The disease develops rapidly both during the prenatal and the postnatal life, though the manifestations may not be clearly evident for some time after birth. In 1914, I reported with Dr. Blackfan a series of 18 cases of hydrocephalus, and in 1917 a series of 25 cases[1], in which complete studies on the absorption of cerebrospinal fluid were made during life. Tests were devised to differentiate the types of hydrocephalus and other tests to obtain an index of the functions of the ventricles and the cerebrospinal spaces. The subdivision of most cases of hydrocephalus into two main classes, communicating and obstructive, still holds. In reality, nearly all cases of hydrocephalus are due to an obstruction, but in the so-called obstructive group the obstruction is in some part of the ventricular system. In the so-called communicating group, the ventricles are in communication with the subarachnoid space and the obstruction, usually adhesions, lies in the various parts of the subarachnoid space. The differentiation into these two great groups is clinically possible and easy of accomplishment by using a colored dye test. If, after injection of the dye into a lateral ventricle, it quickly appears in the spinal canal (lumbar puncture), there is communication between the ventricles and the subarachnoid space, and this type of hydrocephalus is known as "communicating." The absence of the dye in the spinal fluid denotes an obstruction at some point in the ventricular system; this type is called "obstructive." Obviously, this differentiation is of the utmost importance in determining the type of surgical treatment which is necessary.

From the later series of 25 cases, necropsy was obtained in 11; of this number, 4 were caused by obliteration of the aqueduct of Sylvius. Doubtless, several more had a similar lesion, but the absolute proof from necropsy was lacking.

[1] Dandy, W. E., and Blackfan, K. D. Internal hydrocephalus, an experimental, clinical, and pathological study. Am. J. Dis. Child., 1914, viii, 406; Beitr. z. klin. Chir., 1914, xciii, 392; Am. J. Dis. Child., 1917, xiv, 424 (second paper).

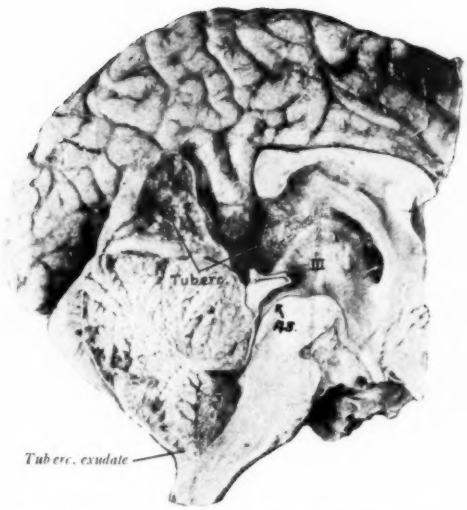

Fig. 1. Sagittal view of normal brain; *a.s.*, normal aqueduct of Sylvius; *III* and *IV*, third and fourth ventricles respectively.

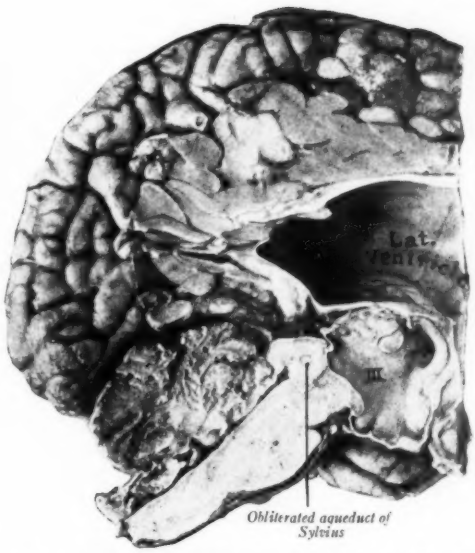

Fig. 2. Sagittal view of brain with hydrocephalus due to complete occlusion of the aqueduct of Sylvius. Note the dilated third and lateral ventricles which are anterior to the obstruction; and the collapsed fourth ventricle which is posterior to and therefore unaffected by the obstruction.

Fourteen of the total number of cases in the series were shown by the dye test to be of the obstructive type and the remaining 11 to be of the communicating type. An analysis of the 14 cases of the obstructive type shows the relative incidence of those cases in which the obstruction was at the aqueduct of Sylvius. Necropsy was obtained in 8 of these 14 cases, and in half of them (4 cases) the aqueduct was occluded and, of course, this obstruction was the etiological factor in each instance, for the aqueduct cannot be occluded without hydrocephalus resulting. Two of these 8 cases were under observation during an attack of acute meningitis, and hydrocephalus was observed to follow this illness. In one case the meningitis was tuberculous, and in the other it was of influenzal origin. Six cases remain of this obstructive group (of the 8 cases in which a postmortem examination was obtained), in which the hydrocephalus was of congenital origin: 4 of these had an obstruction at the aqueduct of Sylvius and 2 at the base of the brain (occluding the foramina of Magendie and Luschka by adhesions). This percentage (66 per cent) should, I think, express about a fair relative incidence of obstructions at the aqueduct of Sylvius in all cases of *congenital hydrocephalus* of the *obstructive* type. In other words, congenital occlusions at the aqueduct of Sylvius are probably at least twice as frequent as those at the foramina of Magendie and Luschka.

Since the publication of the above series, I have had 25 additional cases of hydrocephalus; 10 were of the communicating and 15 of the obstructive type. Postmortem examinations were obtained in 5 of the 10 cases of communicating hydrocephalus and, as in the previous series, the disease was caused by an inflammatory process which sealed the branches of the subarachnoid space, usually the cisternæ. Necropsies were obtained in 5 of the 15 cases of obstructive hydrocephalus, and in each the obstruction was located at the aqueduct of Sylvius. In 3 additional recent cases of hydrocephalus which have been treated by operation, total occlusion at the aqueduct has been found in each instance. Undoubtedly, the same cause would be present in many of the re-

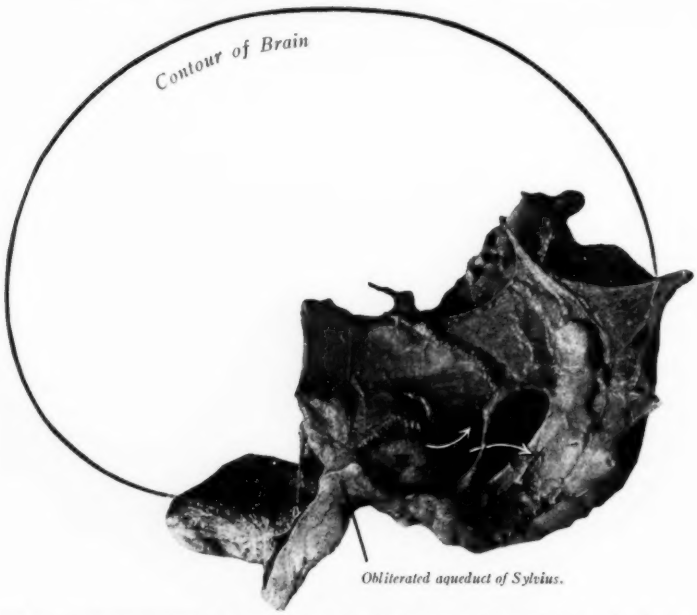

Fig. 3. Sagittal view of the remains of a brain almost destroyed by the hydrocephalus. Note the obliterated aqueduct of Sylvius, the tremendous foramina of Monro which are indicated by the arrows. The cortex of the brain was of paper thinness and in many places completely absent. The contour of the brain is drawn. The fourth ventricle is normal, the cerebellum greatly compressed. Compare the destruction of brain in this case with that in Figure 2. The difference must be due to the time at which the obstruction of the aqueduct developed in intra-uterine life. The age of each case is approximately the same.

maining 7 cases had a postmortem examination been made. In this series of 25 cases, 50 per cent of the autopsies and operations showed the aqueduct of Sylvius to be occluded (exactly the same percentage as in the other series). Stenosis of the aqueduct is, therefore, the causative lesion in about one-half of all cases of hydrocephalus occurring congenitally.

CASES OF STENOSIS OF THE AQUEDUCT OF SYLVIUS COLLECTED FROM THE LITERATURE

Magendie[1] described an occlusion of the aqueduct of Sylvius in 1842; a marked dilatation of the lateral ventricles was also mentioned and discussed as having a probable relationship to the stricture, but this view was finally dismissed and the ventricular dilatation was regarded as incidental rather than causative.

Prior to Magendie's epoch-making publication, in which mention of the stricture of the iter was a mere incident, rational pathological descriptions were scarcely possible, for the normal was not known. Not until then was it known that the cavities in and around the brain contained fluid; Magendie discovered the foramen of Magendie, but even this opening is disputed to the present day. The foramina of Luschka were described several years later. Strictures of such a minute and apparently unimportant channel as the aqueduct of Sylvius could hardly have elicited any serious comment.

Oppenheim[2] (1900) discovered a unique abnormality of the aqueduct at the necropsy of a patient who had suffered from a malady which had been diagnosed as myasthenia gravis during life. A thin bridge of tissue longitudinally bisected the iter (Fig. 5); in addition, numerous tiny nodules composed of lymphocytes protruded into the lumen of the aqueduct. The bisecting bridge had a very thin fibrous tissue center and was completely covered on either side by ependyma. There was no dilatation of the third or lateral ventricles, and in all probability the abnormality produced no injurious primary or secondary effects.

[1] Magendie, F. Recherches physiologiques et cliniques sur le liquide céphalo-rachidien ou cérébro-spinal. Paris, 1842.

[2] Oppenheim. Monatschr. f. Psychiat. u. Neurol., Berl., 1900, March, p. 177.

Fig. 4. Microscopical remnant of the aqueduct of Sylvius from the case shown in Figure 2. The surrounding tissue is glia.

Bourneville and Noir[1] (1900) described a total occlusion of the iter, but, curiously, they placed no importance on the absence of this channel. Even tremendous enlargement of the third and both lateral ventricles of this case, contrasted to the normal small fourth ventricle, produced no impression on these authors who had the etiology of hydrocephalus in their hands but utterly failed to grasp it. They conclude, "Nothing whatever distinguishes this autopsy from that on any other case of hydrocephalus. Nevertheless we note the complete obliteration of the aqueduct of Sylvius which is not ordinarily present." Even at this recent date, the cause of hydrocephalus was not recognized! The most careful and painstaking postmortem examinations frequently revealed the correct pathological lesions, but they were dismissed because they conflicted with current whimsical theories. Even the great Monro, nearly a century and a half ago, found several pathological specimens with mechanical obstructions in the ventricular system but, in his endeavor to prove the ventricles to be independent

[1] Bourneville and Noir. Le Progrès méd., 1900, July 14, p. 17.

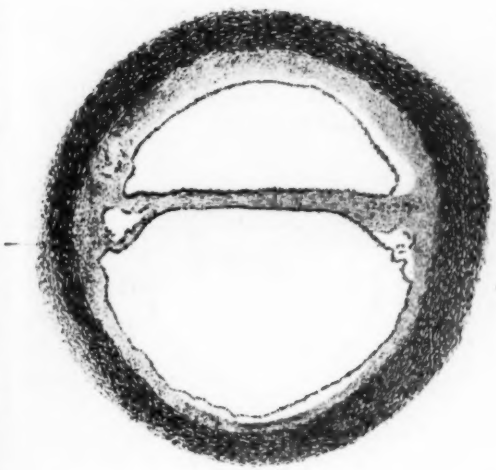

Fig. 5. Photograph taken from Oppenheim's case. This is the only recorded instance of a bridge across the aqueduct. It will be seen that the bridge is composed of a fibrous tissue base but is entirely covered by epithelium.

of any communication with the exterior of the brain, discarded these findings as insignificant.

Touche[2] records a most remarkable case of hydrocephalus which began with a series of convulsions when patient was 4 years of age. There was nothing in the history to indicate that the acute illness was or was not an inflammation, but the head began to enlarge shortly after this illness, prior to which the child had been perfectly normal. The patient lived to be 29 years old, at which time there was almost complete paralysis of both arms and legs, almost total lack of intelligence, and pronounced limitations of the extra-ocular movements. At autopsy, the third and both lateral ventricles were enormously dilated, the iter was completely occluded, and the fourth ventricle was not enlarged. Touche was the first among the references I have found who attributed the hydrocephalus to the obliteration of the aqueduct, though he does not discuss this relationship. No microscopic study of the mesencephalon was made.

Spiller[3] (1902) reported two cases, each with a cicatricial stenosis of an interventricular passage, one at the foramen of Monro, the other at the aqueduct of Sylvius. He is the first to study the stricture microscopically and describes an hypertrophy of glia enclosing numerous minute rests of the epithelial lining of the aqueduct. The stenosis of the foramen of Monro (followed by unilateral hydrocephalus) was also due to a cicatrix. He thought both occlusions to be of inflammatory origin, pos-

[2] Touche. Bull. et mém. Soc. méd. d. hôp., Par., 1902, xix, 141.

[3] Spiller. Am. J. M. Sc., 1902, cxxiv 24.

TABLE OF CASES OF STRICTURE OF THE AQUEDUCT OF SYLVIUS COLLECTED FROM THE LITERATURE

	Author	Age of Patient	Time of Onset of Symptoms	Antecedent or Other Illness Etiological Factors	Signs and Symptoms	Gross Pathology	Microscopic Pathology	General Statement
1	Oppenheim	Adult			Treated as bulbar paralysis	Bridge across aqueduct	Hypertrophy of glia Numerous small nodules	No symptoms of intracranial pressure because obstruction slight, if any
2	Bourneville and Noir	9 years	At 6 months or before	Mother had smallpox — premature delivery	Epilepsy Spasticity Sexual precocity	No trace of aqueduct		Child always weak. No intelligence. Somatic development not unusual. Marked sexual precocity Lays no emphasis on occlusion of aqueduct
3	Touche	29 years	At 4 years	Convulsions for 2 months	Large head. Absence of mentality. Bilateral paralysis almost complete. Partial ophthalmoplegia	Aqueduct occluded completely. Third and both lateral ventricles large. Fourth normal size	None	Patient lived 25 years after hydrocephalus was evident
4	Spiller	19	Doubtful		Difficulty in walking Staggering dizziness	Aqueduct closed third and lateral ventricles. Fourth normal	Tiny opening microscopically Neuroglia increased Ependymal cells in groups	Headaches since childhood
5	Guthrie					No trace of aqueduct		Fourth ventricle small
6	Guthrie					No trace of aqueduct		Fourth ventricle also dilated No evidence of meningitis at necropsy
7	Dandy and Blackfan	6 months	Noticed at birth	None	Large head, circumference 40 centimeters Arms and legs spastic	Total occlusion of aqueduct. Small pouch at third ventricle	Microscopic remnants of aqueduct Hypertrophy of glia	Myelomeningocele also present Third and both lateral ventricles large
8	Dandy and Blackfan	6 weeks	Large head at birth	None	Large head, circumference 50 centimeters Convulsions began second week. Extra-ocular palsies, nystagmus	Cerebral hemispheres almost completely destroyed. Aqueduct completely occluded	No microscopic remnants of aqueduct. Increased production of glia	Very advanced. Total occlusion must have existed early in intra-uterine life. Fourth ventricle mere slit. Third and both lateral ventricles extremely large
9	Dandy and Blackfan	5 years	Head large at birth Abnormal at 4½ months Never able to hold up head	None	Head 54 centimeters; grew to 72 centimeters. Strabismus Spasticity of arms and legs Wassermann negative	Double obstruction (1) Aqueduct Sylvius (2) Foramina of Luschka and Magendie		Patient was observed 5 years. Some development of speech and slight intelligence despite progress of disease Hydronephrosis (bilateral) due to a congenital obstruction of the urethra

10	Schlapp and Gere	3½ years at death	Head large at birth	Fall when 2½ years old Unconscious several minutes; vomiting. Headaches, epilepsy, and irritability began 6 weeks later	Unsteady gait, irritability, headache, convulsions No extra-ocular palsies. Choked disc No ataxia No Romberg Slight nystagmus Head 62 centimeters	Complete occlusion of aqueduct. Tiny cysts	Increase of glia Cellular changes in wall of ventricles, probably inflammatory	The large head at birth suggests a congenital origin though the trauma may be important either for originating the stricture or for causing a partial one to become complete
11	Schlapp and Gere	5½ months	Head large at 1 month Normal at birth	Instrumental delivery	Convulsions Head 63 centimeters. Limbs spastic Knee kicks active	Complete closure of aqueduct Upper part of aqueduct greatly dilated. Brain membrane thick	Increase in glia	
12	Schlapp and Gere	2½ years	Head large at birth, gradually increased	None mentioned	Head 67 centimeters Never able to move arms or legs Probably blind or deaf	Cortex ½ centimeter Ventricles large Aqueduct entirely closed	Hypertrophy of glia	
13	Schlapp and Gere	6 months	Large since birth		One eye turned out since birth. Blind Bilateral ankle-clonus and Babinski	Head 10½ centimeters Tumor of fourth ventricle	Hypertrophy of glia with cyst formation entire length of aqueduct	
14	Schlapp and Gere	15 months				Head 67 centimeters. Several small gliomata occlude aqueduct completely		
15	Schlapp and Gere					Little brain tissue left	Cellular reaction around aqueduct which is closed	Evidence of syphilis
16	Schlapp and Gere	Birth	Before birth			Aqueduct closed	Increase of glia Small slit open microscopically	
17	Dandy	2 months	1½ months	None	Head 40.5 centimeters	Tiny opening of aqueduct remains	Increased glia	Talipes equinovarus. Spina bifida. Myelomeningocele Obstruction of the aqueduct is not quite complete
18	Dandy	4 months	Head large at birth	Easy labor	Head 68 centimeters Slight strabismus Child died of pneumonia No operation	Thin band across aqueduct	None made	This band could undoubtedly have been treated at operation, probably permanently
19	Dandy	3 months	1½ months	Easy labor Head noticed to be large at age of 6 weeks	Head 50.5 centimeters	Total occlusion of aqueduct	None made	Tube was passed over aqueduct; because the cerebellum was not split, the view was obscured. Death followed operation
20	Dandy	3 months	Head large at birth		Head 48.75 centimeters One month later was 53.75 centimeters	Total occlusion of aqueduct	None made	Death followed incision of ventricle

Fig. 6. Photograph of patient having partial occlusion of the aqueduct of Sylvius.

sibly tuberculous, and to be the cause of the hydrocephalus in each.

In an admirable article, Guthrie[1] (1910) reported studies in hydrocephalus from a large series of postmortem examinations of patients who died of meningitis or its sequelæ. His views on the relationship of meningitis to the production of hydrocephalus were most sane and on the whole far in advance of contemporary articles on hydrocephalus. He emphasizes a relationship of diseases which is certainly correct and all-important, but one which is even now poorly recognized. Eight cases of complete occlusion of the iter were included in his report; in 6, the occlusion was undoubtedly inflammatory and occurred during the progress of the meningitis. In 2 cases of hydrocephalus (which alone of his series are included in this report of cases collected from the literature), there was neither a history nor any postmortem evidence of meningitis, but the aqueduct of Sylvius was totally occluded in each. The possible relationship of meningitis to the formation of these strictures, as implied by Guthrie, will be discussed later.

Schlapp and Gere[2] (1911) presented a series of 4 cases, each having complete occlusion of the iter; later (1917) the number was increased to seven.[2a] All of these cases were carefully studied microscopically.

[1] Guthrie, L. S. Practitioner, 1910, lxxxv, 47.

Schlapp and Gere. Am. J. Dis. Child., 1917, xiii, 461; Proc. New York Path. Soc., 1911, p. 64.

[2a] An additional case is not included here because the obstruction at the aqueduct was due to a tumor. The symptoms, incidence and treatment of such lesions are entirely different and will be considered subsequently.

PATHOLOGY OF STRICTURES OF THE AQUEDUCT

All of these cases, including the 3 entered by Blackfan and myself,[3] have essentially the same microscopic pathology which was described by Spiller. In each instance, only epithelial remnants of the lining ependyma remain, and an hypertrophy of the glial tissue replaces the defect. In one of our cases, not a trace of epithelium could be found in any of the sections, but the other 2 which were so examined had microscopic tubular remains of ependyma; but no possible channel could be reconstructed from the third to the fourth ventricle through this connective tissue.

In the gross, the region of the occluded iter differs but little from the surrounding mesencephalic tissue. There is usually no increased density noticeable to the touch and one gets the impression of a normal mesencephalon minus the aqueduct. In one of our cases, however, the region of the aqueduct appeared fairly sharply circumscribed, almost like a tumor; it was much harder and more fibrous but microscopically the picture was similar to that of the others.

In 4 of our 7 cases, the entire length of the aqueduct was occluded. In 1, the stricture was not quite complete (Fig. 8), though phenolsulphonephthalein did not appear in the spinal fluid within a half hour after it had been injected into the lateral ventricle, as it normally should when the aqueduct is patent. In one case, the stricture was a very thin diaphragm which transmitted light and should easily have been amenable to treatment. In another case, there were two obstructions in the ventricular system, one at the iter, the second at the base of the brain (Figs. 9 and 10). The fourth ventricle, which intervened between the strictures, was markedly dilated as should be expected from failure of its fluid to escape into the cisterna magna. The stricture at the aqueduct was only about 3 millimeters in length. Apparently one of Guthrie's cases, also, had two such obstructions and at the same locations, for the fourth ventricle was enlarged, a finding which could not occur unless both foramina of Luschka together with the foramen of

[3] Dandy and Blackfan. Loc. cit.

Fig. 7. Cross section of brain of a 3 months old baby (Fig. 6) with hydrocephalus resulting from a partial but nearly complete obstruction of the aqueduct of Sylvius. The septum lucidum is completely gone. The anterior part of the aqueduct is dilated.

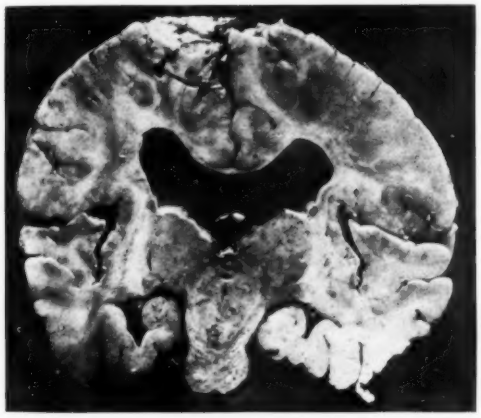

Fig. 8. Cross section of the same brain as in Figure 7, showing tiny slit remaining as the aqueduct. This is the narrowest part of the channel. Though small, the lumen still allows a certain amount of fluid to pass and reduces the degree of hydrocephalus.

Magendie were closed. In 2 of the cases described by Schlapp and Gere, only the posterior end of the aqueduct was occluded, the anterior part being dilated up to the point of the stricture. This was also true in one of our specimens.

It is hardly necessary to note that in every case in which the aqueduct of Sylvius is occluded, the third and both lateral ventricles are dilated, the degree varying with the time which has lapsed after the stricture has formed. The size of the fourth ventricle is not increased except in those rare cases in which the foramina of Luschka and Magendie are also occluded (Figs. 9 and 10); it is usually, though not invariably, smaller than normal because of the superimposed pressure of the hydrocephalic ventricles (Figs. 2 and 3), although this pressure is greatly reduced by the comparatively inelastic tentorium cerebelli which holds the heavy cerebral hemispheres. The reason the third and both lateral ventricles dilate is because the closure of the aqueduct of Sylvius removes the only avenue by which the cerebrospinal fluid can escape from these ventricles. And, since there is only a trivial amount of absorption through the walls of the ventricles and a constant formation of fluid within the ventricles from the choroid plexus, the ventricles must continue to enlarge. To compensate for this enlargement, the brain is steadily destroyed. In most of the cases included in this series and reported by various authors the ventricles had reached extreme dilatation and the amount of cerebral cortex which remained was small. In 2 of our cases, there was only a film of brain remaining and this was attached to the leptomeninges; and in many areas of considerable size the brain tissue was entirely absent.

By the newer methods, it is now possible to determine the presence of hydrocephalus in the earlier stages of its development. It is no longer necessary to await progressive enlargement of the head with the great destruction of brain tissue. In one of our cases, the hydrocephalus was suspected at birth on account of the presence of a myelomeningocele and of an unusually large anterior fontanelle.

The presence of a meningocele should always be looked upon as a suspicious sign that hydrocephalus may be an accompanying condition which may be far more serious than the meningocele. The cause of the frequent association of hydrocephalus and meningocele is as yet not entirely clear, but the importance and frequency of the relationship cannot be overestimated.

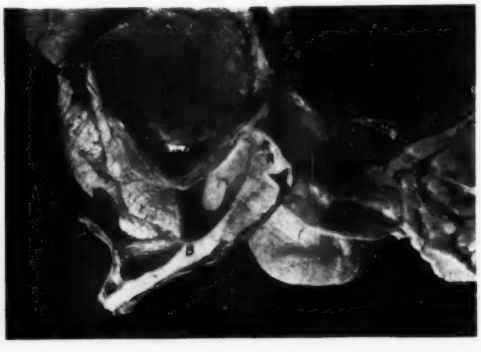

Fig. 9. Mid-sagittal section of a brain of a patient with hydrocephalus which was first noticed several weeks after birth. The patient died when 5½ years old, of an intercurrent disease. There are two obstructions present, both complete; one is at the aqueduct of Sylvius, the other at the foramina of Magendie and Luschka. The latter occlusion accounts for the dilated fourth ventricle. This patient also had a congenital stricture in the prostatic urethra and a resulting bilateral hydronephrosis. *a*, Obstruction of aqueduct of Sylvius; *b*, obstruction of foramen of Magendie.

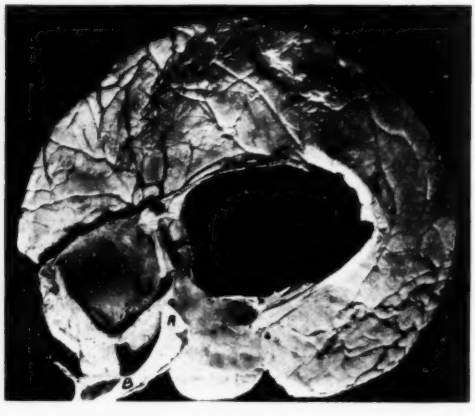

Fig. 10. Same specimen as shown in Figure 9 with lower magnification to show relative size of the enlarged brain. *a*, Obliterated aqueduct of Sylvius; *b*, obliterated foramen of Magendie.

THE CAUSE OF STRICTURE OF THE AQUEDUCT

During early embryonic development, the aqueduct of Sylvius shows no differentiation from the remainder of the neural tube. Everywhere the entire neural canal, including the aqueduct of Sylvius, therefore, must necessarily have been patent and lined by epithelium. It is easy to understand how the foramina of Luschka and Magendie may be impermeable, simply because they have failed to develop, because they are secondary openings from a primary closed neural tube; but no such hypothesis is tenable in explaining stenosis of the aqueduct of Sylvius. Since, therefore, the aqueduct of Sylvius is primarily an open tube, its closure must be secondary and never due to agenesis. The presence of microscopic epithelial (Fig. 4) remains and occasionally of a minute patent channel, evident at times even macroscopically, serve as supporting evidence that the iter has been in existence but has been subsequently occluded by some abnormal process.

The aqueduct is the weakest and at the same time the most important link in the ventricular system. Its lumen should normally be open for the passage of cerebrospinal fluid which is constantly but very slowly being poured through it. The hypertrophy of glia cannot be regarded as a tumor because it has not the cellular element of a tumor; moreover, it does not proliferate beyond the immediate region of the iter.

Glia behaves essentially as does connective tissue. Its growth must be secondary and not primary. It would be difficult to imagine a primary rampant growth of connective tissue beyond the confines of a normal epithelial lining. It would appear more probable that a primary destruction of the epithelial lining of the aqueduct had resulted and the natural attempt of nature to heal the breach by glial tissue had resulted in the stenosis of the iter at the affected zone. Such an hypothesis, and of course more it cannot be, is supported by the method of formation of stenoses elsewhere in the body, either by trauma plus infection, or even by infection alone. The closure of only a portion of the aqueduct in many cases supports the view that an epithelial defect is primary, for a primary connective-tissue growth would hardly be so restricted.

We know that intracranial intra-uterine inflammations do exist, because adhesions are so frequently found over the surface of the brain. We have no information by which it is possible to decide whether these inflammatory changes are the result of bacteria or merely

Fig. 11. Lateral view of patient with hydrocephalus caused by a stricture of the aqueduct of Sylvius. A new aqueduct was constructed as described in the subsequent figures. He is still living and greatly improved 1 year after the operation.

Fig. 12. View of operative wound of same patient 2 weeks after operation.

toxins, but this differentiation is irrelevant. There is every reason why the aqueduct of Sylvius should be most susceptible to any such intra-uterine inflammatory changes. Its relatively great length, together with its tiny caliber, makes it a place of least resistance both to trauma and to inflammatory changes or to both; and it is easily conceivable that only a relatively slight injury to the aqueduct, either by trauma or by toxins, would be necessary to produce sufficient destruction of the epithelium to result in a stricture—which could scarcely be reparable by any method of nature.

In this connection, there are several findings in the above series of cases which are important. Oppenheim's case was characterized by a number of small nodules which protruded into the lumen and which were made up of clusters of lymphocytes. Similar lymphocytic changes, which have been interpreted as inflammatory by the authors, were described by Schlapp and Gere in two of their cases. In all of our cases, and doubtless most of the others which are recorded here, the process is too old to record any cellular inflammatory reaction, had such changes been present at the time of onset of the lesion. It is not necessary to relegate all possible inflammatory changes to the overcrowded and underreasoned syphilitic category, for there must be many types of mild inflammatory changes of which we know very little at the present time. Guthrie's observations bear the greatest weight in this connection. He found in postmortem examinations of a series of patients who had died of meningitis, 8 instances in which total occlusion of the aqueduct had resulted from the inflammations. In all of his cases, the meningitis was post-

Fig. 13. Ventriculogram from a case of hydrocephalus diagnosed at birth. The ventriculogram shows the third ventricle filled with air in addition to one lateral ventricle. There is no air in the fourth ventricle. The obstruction is therefore at the aqueduct of Sylvius.

natal. Undoubtedly, the aqueduct is much more resistant to injury after birth and becomes progressively more so; this statement is made upon the relative infrequency of stenosis of the aqueduct with increasing age. If, therefore, inflammations can occlude the aqueduct so frequently after birth, a relatively trivial infection or irritant would doubtless produce the same disastrous results in the tender period of intra-uterine life.

ANALYSIS OF THE CLINICAL MANIFESTATIONS IN THIS SERIES

A large head of varying size is the only constant feature of these cases and, obviously, the large head is a manifestation of all types of hydrocephalus and not of obstructions of the aqueduct in particular. The size of the head is only very roughly proportional to the size of the lateral ventricles. At birth the head may be only slightly enlarged or, as usually happens, may attract no attention whatever and still the ventricles may be several times the normal size. Any appreciable enlargement of the head means a very great enlargement of the ventricles and a corresponding amount of destruction of brain tissue. The size of the head is, therefore, only a very rough index of the condition of the contents of the cranial chamber; the small head is a very poor index, if any at all; the large head is a very good index. After the first few years of life, the size of the head changes but slightly despite great enlargement of the ventricles, because the united bones preclude much separation. We have made several diagnoses of early hydrocephalus soon after birth by carefully examining the anterior fontanelle for enlargement, fulness, and alteration of shape. Not infrequently the anterior and posterior fontanelles are continuous, owing to separation of the interparietal suture. The anterior fontanelle will also usually project farther forward than normal and farther lateralward by separation of the interfrontal and frontoparietal sutures respectively.

It is quite remarkable how a limited amount of intelligence may continue to develop in young children in spite of the rapid progressive destruction of the brain. Even with an enormous head, measuring 60 to 70 centimeters in circumference (Figs. 9 and 10), the child may learn to speak distinctly though, of course, with a greatly restricted vocabulary. A considerable amount of destruction of the brain may be tolerated in the early stages of hydrocephalus without any or with only moderate mental inferiority; this holds true only so far, after which the mental changes progress rapidly and, of course, are irreparable.

Many hydrocephalic children have a downward displacement of the eyes due to depression of the roof of the orbit. Owing to this displacement, the sclera shows above the iris and the iris is partially covered below. Quite frequently there is also a considerable limitation of the various extra-ocular movements. This is usually symmetrical, though one set of muscles may be more involved in one eye than the other. I believe these palsies are due, not to implication of the quadrigeminal bodies as could be readily inferred from the close proximity of these bodies to the iter, but rather to the pressure of the bulging, distended third ventricle which presses upon the third, fourth, and sixth nerves directly. Were the affection in the quadrigeminal bodies or in the nuclei of the third nerves which are located in the mesencephalon, the

extra-ocular palsies would be complete rather than partial.

Convulsions are not uncommonly present, though probably the majority of patients are not so afflicted, or have only an occasional attack; the attacks are general and may be both petit mal and grand mal. Their explanation is still obscure because of our meager knowledge of the underlying cause. Spasticity of the arms and legs is also frequent, doubtless from pressure of the intraventricular fluid on the thinning pyramidal tract. Eventually, this destruction leads to complete paralysis of the arms and legs.

Blindness is not infrequent, even when the head can enlarge quite readily. The optic nerves are directly compressed by the distended third ventricle which thus produces the loss of vision. Ankle clonus, Babinski and Oppenheim reflexes are present with varying frequency. The reflexes are usually exaggerated, in keeping with the degree of spasticity. One might expect to find a choked disc constantly, but most cases have a primary atrophy instead; the explanation for this fact is that the third ventricle acts as a tumor and presses on the optic chiasm directly, thus occluding the space in the sheath of the nerves.

But all of these signs and symptoms are not present in every case or even type of hydrocephalus. They are the manifestations of hydrocephalus, and have no direct bearing upon the primary lesion in the aqueduct of Sylvius or elsewhere. Moreover, there is no sign or symptom which is characteristic of a stricture of the aqueduct of Sylvius as such. A tumor in the mid-brain blocking the aqueduct of Sylvius has signs which are pathognomonic, but only because the contiguous nuclei or the quadrigeminal bodies are involved. Were the hypertrophied glia a progressive lesion, it would likewise involve these contiguous structures and produce the same signs but, being restricted, only the signs of pressure are usually present.

CASE WITH TWO OBSTRUCTIONS, ONE AT THE AQUEDUCT OF SYLVIUS, THE OTHER AT THE FORAMINA OF LUSCHKA AND MAGENDIE.

This patient was 5 years old at the time of his death. He had been under observation from time to time for 4½ years, during which time the size of his head steadily increased. The patient was the third of five children, the others being hearty and well. There is no history of tuberculosis or syphilis in the family. The birth was at full time and the delivery not abnormal though more difficult than the others. When one month old, the patient had two "inward spasms"; the head was thrown back and the eyes rolled up; these spells were apparently convulsions and never reappeared. There has never been a history of meningitis. When 3 months old, it was definitely agreed that his head was abnormally large. Before this time, however, the neighbors had commented on the "large round head." When 4½ years old, he had "screaming spells" almost daily, but these were not associated with convulsions or vomiting. At this time, the family physician made the diagnosis of water on the brain. Feeding was uneventful and he thrived and his body grew normally. He was never able to hold up his head, to sit up or to walk. When a year old, it was noticed that his left arm was weaker than the right. The fontanelles remained open and wide. When 9 months old, the anterior fontanelle measured 11 centimeters transversely and 9 centimeters anteroposteriorly. The posterior fontanelle was closed. Two years later (2½ years old) the fontanelle measured 10 by 9.75 centimeters. The head measurements at various intervals are as follows:

When 6½ months old, 52.5 centimeters.
When 9 months old, 54.0 centimeters.
When 13 months old, 56.0 centimeters.
When 14 months old, 57.0 centimeters.
When 15 months old, 57.8 centimeters (puncture of corpus callosum done 1 month ago).
When 23 months old, 62.0 centimeters.
When 29 months old, 64.0 centimeters.
When 33 months old, 65.0 centimeters.
When 60 months old, 68.0 centimeters (at time of death).

This happens to be the first case of hydrocephalus in which the absorption from the ventricles and the subarachnoid space was tested by the phenolsulphonephthalein test. It was found that the dye appeared in the urine 55 minutes after injection into the ventricle and in 2 hours following the appearance time only 0.5 per cent was excreted by the kidneys which were shown to have a normal function. Spinal punctures, repeatedly made, yielded only 2 to 3 cubic centimeters of clear fluid, containing none of the phenolsulphonephthalein, thereby demonstrating the absence of communication between the ventricles and the subarachnoid space. When phthalein was injected into the ventricles, a normal absorption, 35 per cent in 2 hours, was obtained. The cause of the hydrocephalus is evident from these studies. An obstruction was indicated and, because of the very small amount of fluid obtained at lumbar puncture, the obstruction was thought to be at the foramina of Luschka and Magendie. These observations were made before the institution of surgical treatment was advisable.

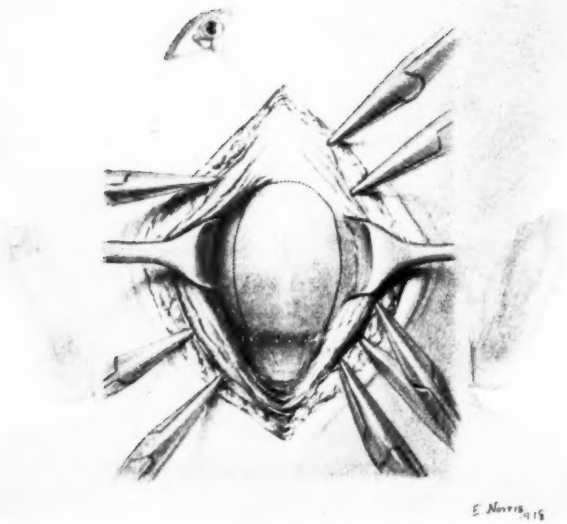

Fig. 14. This and the succeeding drawings by Miss Norris show the operative procedure, in which the stricture of the aqueduct of Sylvius is opened and enlarged and the tube inserted to maintain the opening. In this figure the wound is shown. The occipital muscles are separated in the mid-line and the bone exposed. A ventricular puncture is made to reduce the intracranial pressure.

A puncture of the corpus callosum was made when the child was 14 months old, but no beneficial results were obtained. The child died when 5 years old of bilateral pyonephrosis which was caused by a congenital urethral stricture. The foramina of Magendie and Luschka were occluded but the surprising finding was the second obstruction at the aqueduct of Sylvius (Figs. 9 and 10). The third ventricle and particularly the lateral ventricles were tremendously distended. The fourth ventricle was moderately distended.

Had the obstruction been solely at the aqueduct of Sylvius, the size of the fourth ventricle would not have been increased and, conversely with an obstruction at the aqueduct, the fourth ventricle could dilate only when the foramina of Luschka and Magendie are obstructed.

CASE OF PARTIAL BUT NEARLY TOTAL OCCLUSION OF THE AQUEDUCT OF SYLVIUS

Patient was first seen when 6 weeks old. It was apparent at that time from the large fontanelle that hydrocephalus was present though the size of the head was normal, and no abnormality of the head had been suspected by the parents. In 2 weeks, the circumference of the head increased 3 centimeters and then measured 39 centimeters. A meningocele had been partially excised 2 days after birth, and the patient was brought to me to complete the excision of the meningocele. The wound had healed and no nerve palsies had followed. The sagittal suture was open, uniting the anterior and posterior fontanelles.

A ventriculogram shows a large lateral ventricle, at least four times the normal size, leaving a greatly

reduced cortex. On spinal puncture, only 5 cubic centimeters of fluid were obtained and indigo-carmine, which had been injected into the lateral ventricle, did not appear in the spinal fluid in 35 minutes. Unfortunately, a puncture was not made 1 hour after the injection, for a trace of fluid might have been present at that time. This inference is made because at autopsy the aqueduct was reduced to a channel of filiform size. It was really still a partial obstruction though nearly complete, and sufficiently complete to cause the high grade hydrocephalus. The foramina of Luschka and Magendie were patent and of normal size. The third and both lateral ventricles were greatly dilated, the fourth ventricle was very small. Undoubtedly, this is a progressive lesion and shortly the lumen would have been completely closed as in the other cases.

DIAGNOSIS OF A STRICTURE OF THE AQUEDUCT OF SYLVIUS

An occlusion of the aqueduct of Sylvius can now be accurately localized. It is first necessary to prove the existence of hydrocephalus; second, to find whether it is of the obstructive or of the communicating type; and finally, if obstructive, to locate the obstruction. Unfortunately, hydrocephalus is now usually diagnosed only in the late or relatively late stages of the disease by the characteristic enlargement of the head; at this stage, the diagnosis is just as easily made by the parent as by the physician. Moreover, when any considerable enlargement of the head is present, the destruction of the brain is so great that the practical value of the diagnosis is relatively slight, for any effective treatment would leave the patient mentally deficient.

In the early stages of hydrocephalus in children, and in all cases after union of the sutures, the diagnosis of hydrocephalus is extremely difficult. But the important time to make a diagnosis is at the beginning of the disease, before the large head has made the diagnosis unquestioned. It is not within the scope of this paper to deal with this most important phase of hydrocephalus—the early diagnosis—but it should always be eagerly borne in mind and when suspected, the patient should be referred to a competent authority to ascertain definitely whether or not this condition is present. This diagnosis can now be made with absolute certainty and the degree of the ventricular dilatation

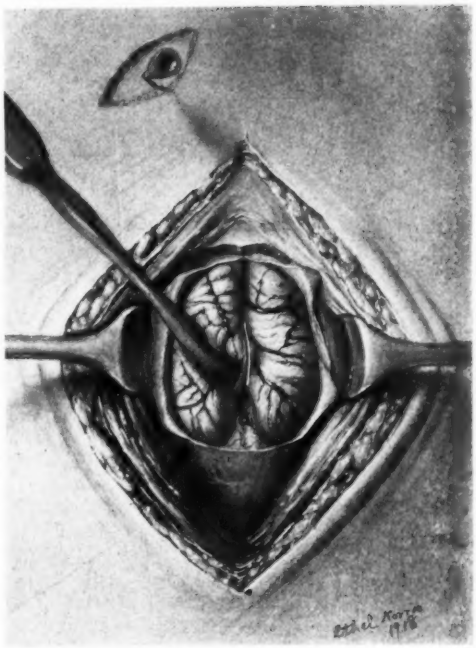

Fig. 15. The cerebellum is exposed. The cerebellum is lifted and the foramen of Magendie exposed *a*. The line in the vermis indicates the site for section of the posterior part of the cerebellum.

determined with absolute accuracy by ventriculography (Fig. 13), and when moderately advanced, not infrequently the condition can be recognized by an X-ray without ventriculography. Without these methods, the determination of the presence or absence of hydrocephalus in the early stages is entirely guesswork, that is until the tell-tale growth of the head has taken place. Careful weekly measurement of the head should always be made until any suspicion of hydrocephalus is allayed or verified. When the diagnosis of hydrocephalus is made, the proper treatment, which depends entirely upon the type of hydrocephalus, should be instituted without delay.

When the diagnosis of hydrocephalus has been made, a simple and safe procedure will determine whether the ventricles communicate with the subarachnoid space and thus determine into which of the two great groups —obstructive hydrocephalus or communicat-

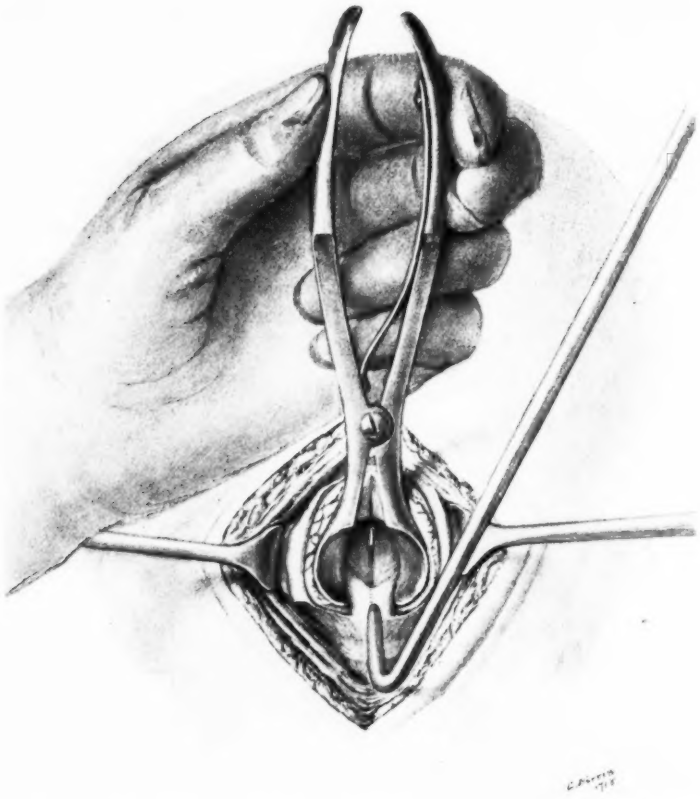

Fig. 16. The dilator is separating the divided surfaces of the cerebellum and exposes the fourth ventricle and the beginning of the aqueduct of Sylvius.

ing hydrocephalus—the particular case belongs. One cubic centimeter of indigo-carmine (or of a carefully neutralized solution of phenolsulphonephthalein, though I have ceased to use this in the ventricles because of an occasional reaction) should be injected into a lateral ventricle and 30 minutes later a lumbar puncture made. If the ventricles communicate with the subarachnoid space, the color will have appeared in quantity in the spinal fluid by this time or very shortly thereafter. The hydrocephalus would, therefore, be of the communicating type and one could be certain that there was *no obstruction* in any part of the ventricular system. For the purposes of this paper it would exclude any occlusion of the aqueduct of Sylvius.

On the other hand, if the dye does not appear in the spinal fluid in this allotted period of time, one could know just as positively that an obstruction existed at some part of the ventricular system; it might be at the foramen of Monro—a rare possibility—or more probably either (1) at the aqueduct of Sylvius or (2) at the basal foramina of Magendie and Luschka (all three must be occluded to produce hydrocephalus). In cases of congenital hydrocephalus, as indicated by statistics given at the beginning of the paper, the chances are about two to one that the obstruction is at the aqueduct of Sylvius, and about one to two that the foramina of Magendie and Luschka are occluded. There are some rarer exceptions to these

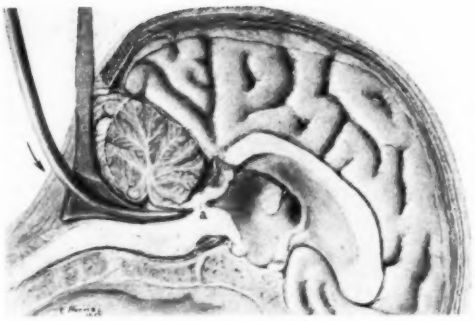

Fig. 17. Sagittal view of brain to show stricture at the aqueduct and the method of piercing it with a steel catheter preparatory to the introduction of the rubber tube.

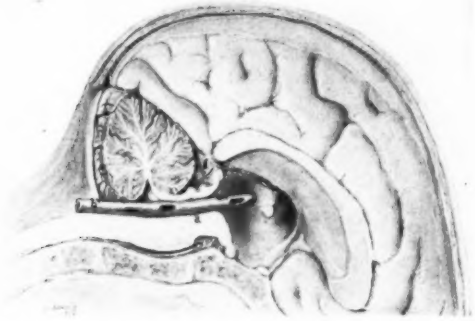

Fig. 18. Sagittal view of brain showing tube in position in the aqueduct of Sylvius. Openings are made in that part of the tube which lies in the third and fourth ventricles. The tube is firmly anchored to the dura with a silk suture at *b*. The tube is buried complete when the occipital muscles and the skin are closed.

interpretations which need not be considered here.

The precise location of the site of the obstruction can be accomplished only by ventriculography.[1] If the obstruction is at the aqueduct of Sylvius, the shadow of the third and particularly of the lateral ventricles will be shown to be greatly dilated, *but no air will be present in the fourth ventricle. If air is in the fourth ventricle, the obstruction cannot be at the aqueduct of Sylvius.* Further differentiation of the types of hydrocephalus by air injections will be considered in greater detail in a paper which will appear shortly. The absence of a shadow of the fourth ventricle must not be taken as conclusive evidence of an occlusion at the iter unless one is confident of a perfect and complete injection, that is one which has almost completely filled both lateral ventricles and in which the head has been properly manipulated in order to permit the air to pass into and remain in the fourth ventricle.

AN OPERATIVE TREATMENT FOR STRICTURES OF THE AQUEDUCT OF SYLVIUS

The difficulties encountered in treating lesions of the aqueduct of Sylvius would appear almost insuperable, but I have been encouraged to the possibilities of a direct attack upon the mesencephalon even in infants by the increasing number of cases in which the aqueduct has been exposed during the extirpation of cerebellar tumors. At least 25 times during the past year it has been possible to watch the cerebrospinal fluid pour through the aqueduct (often enlarged by the hydrocephalus which follows tumors) into the fourth ventricle. On two occasions, a pineal tumor has been exposed and in several instances the exposure of tumors of the anterior part of the vermis or the removal of huge tumors of the cerebellum left this structure in full view. In animals long tedious operations for removal of the pineal body were borne with impunity even when the puppy operated upon was only 3 or 4 days old.

In dogs I have found that an obstruction could be placed in the aqueduct and produce hydrocephalus;[2] later, it could be removed and the hydrocephalus cured. Moreover, an accumulated past experience with the surgical treatment of hydrocephalus would seem to indicate strongly that the treatment of hydrocephalus must be directed toward an attack on the cause of the disease. All efforts at circumventing the cause, such as a puncture of the corpus callosum, or puncture of the wall of a lateral ventricle, are doomed to failure because of anatomical and physio-

[1] Dandy, W. E. Ventriculography following the injection of air into the cerebral ventricles. Ann. Surg. 1918, July; Fluoroscopy of the cerebral ventricles. Bull. Johns Hopkins Hosp., 1919, February; Roentgenography of the brain after the injection of air into the spinal canal. Ann. Surg, 1919, October; Localization or elimination of cerebral tumors by ventriculography. Surg., Gynec. & Obst., 1920, 329.

[2] Dandy, W. E. Experimental hydrocephalus. Ann. Surg., 1919, August.

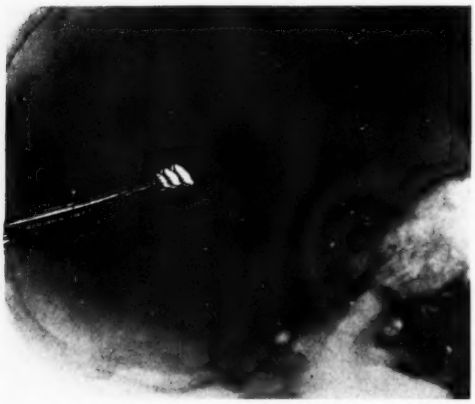

Fig. 19. Roentgenogram showing the tube in the aqueduct of Sylvius. The tube is sutured to the dura at the lower end.

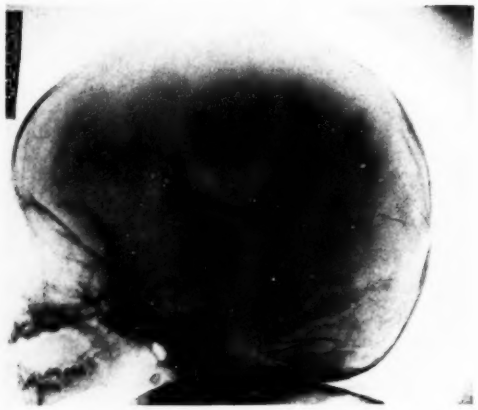

Fig. 20. Roentgenogram of another case showing a larger tube in the aqueduct.

logical factors which must be recognized but which have been disregarded or not known in the empirical treatments instituted heretofore. It seems impossible to produce an opening in the third ventricle which will drain the cerebrospinal fluid into an absorbing area except by way of the normal route into the fourth ventricle. It is necessary that cerebrospinal fluid pass into the cisternæ before it can be distributed into the finer radicles of the subarachnoid space, for it is only there that an adequate absorption of the fluid is possible. The fluid can only reach the cisterna magna by way of the fourth ventricle through the foramina of Luschka and Magendie, and the fourth ventricle can only be reached through the aqueduct of Sylvius. Following a puncture of the corpus callosum, the cerebrospinal fluid passes into the subdural space in which absorption is no greater than in the ventricle from which the fluid escaped. Moreover, the opening in the roof of the ventricle remains patent for a brief period only. All small openings through any considerable thickness of brain tissue must cicatrize unless lined by epithelium and, pending closure of the opening, the fluid which escapes becomes encysted unless it is poured into an absorbing area.

In an attempt to treat the cause directly, I propose a method of reconstructing the obliterated aqueduct of Sylvius. In probably the majority of cases which are collected here, the entire aqueduct is obliterated by a very dense fibrous scar. It is hardly to be expected that any new channel as long as the iter can be permanently maintained after reconstruction, when the entire aqueduct is involved. But in those cases where only a small portion of the aqueduct is occluded, and ideally perhaps where the aqueduct is crossed by a thin diaphragm, or where the obstruction is only partial, a restoration of the iter should appear to be a hopeful possibility.

The operation has been performed twice, on children 1 year and 5 years of age. There was very little reaction to the operation in either case. The older child died 7 weeks later of pneumonia; the younger child is still living. There is, of course, no way that the operator can tell beforehand the longitudinal extent of the obstruction in the iter. It is thus necessary to subject all, in whom the intellectual indications are favorable, to the operation, without which there is not the slightest chance of improvement.

Should there be any doubt as to the site of the obstruction, the absolute decision can be made at the operation without delay or difficulty. After eliminating a foramen of Monro obstruction, by proving communication between the two lateral ventricles, there are only two other possible locations for the occlusion—the foramina of Magendie and

Luschka, and the aqueduct of Sylvius. Fortunately, the same incision is made for the treatment of either lesion. Patency or occlusion of the foramen of Magendie can readily be determined by an operator of experience. The patency or occlusion of the foramina of Luschka is of less importance, for one foramen is adequate to permit egress of all the cerebrospinal fluid. If the foramen of Magendie is patent, the occlusion, by elimination, must be at the aqueduct of Sylvius. On the other hand, 2 cases of double stricture in this series, one at the aqueduct, the other at the foramen of Magendie, emphasize the danger of assuming that the aqueduct is patent after the occlusion of the foramen of Magendie has been relieved. The indigo-carmine test will precisely determine this point.

The steps in the operation are shown in the accompanying drawings (Figs. 14 to 18). After a bilateral exposure of the cerebellum (Fig. 14), the vermis is elevated with a small spatula (Fig. 15), exposing a normal foramen of Magendie and fourth ventricle. Into this a fine catheter is gently passed forward until it is met by the obstruction at the aqueduct of Sylvius. To get a satisfactory exposure it is necessary to divide the lower half of the vermis in the mid-line and carry this incision through the roof of the fourth ventricle (Figs. 15 and 16). A nasal dilator introduced into this defect (Fig. 16) permits a good exposure of the funnel-like anterior terminus of the fourth ventricle and the entrance to the aqueduct of Sylvius. A small sound entering this orifice meets the obstruction and is carefully forced through it into the third ventricle (Fig. 17). Fluid at once freely escapes through the opening which again establishes communication between the third and fourth ventricles. Larger sounds are then passed to increase the size of the lumen. A small rubber catheter is pushed into the newly made channel (Fig. 18) and left in position for a period of 2 to 3 weeks after the operation. The tube is perforated in numerous places to prevent closure of the lumen by fibrin. The walls of that part of the tube which lies in the aqueduct are smooth and are without perforations. The anterior part of the tube projects into the third ventricle, the posterior part is in the fourth ventricle and lies on the pons and medulla. It is anchored with a silk ligature to the dura at the foramen magnum. The end of the tube is cut off at this point and the lumen closed by a ligature. The excess tube which traverses the entire length of the fourth ventricle is necessary to preclude the possibility of the tube becoming dislocated and lost. The nuchal muscles are carefully closed over the wound, giving a good protection of tissues over the large foreign body which is quite deeply buried and is free from skin infections during its abode in the brain.

Such a big foreign body is necessarily accompanied by a reaction of considerable severity which ultimately necessitates its removal at a second operation. I have endeavored to leave the tube in place as long as possible, hoping for epithelization of the iter, and thereby preservation of lumen after the tube has been removed. In one case which died, the tube was left in place 2 weeks, and in the second case it remained 3 weeks. The reaction of the patient to the tube is evident as a general lethargy, loss of appetite, vomiting, loss of weight, temperature elevation, and a full and tight anterior fontanelle, in other words, the manifestations of general intracranial pressure. Signs of pressure quickly disappear after the tube is removed.

It will doubtless seem a radical procedure to hemisect or even partially hemisect the vermis of the cerebellum. I have three patients who are perfectly well after complete removal of the vermis and part of both lobes of the cerebellum, the operations being necessary to remove large tumors. They have no effects of this complete section. In 10 other cases, partial section of the vermis has been necessary and has been devoid of any apparent ill effects. Certainly, it is necessary to see every step in remaking the aqueduct. Inferiorly, the pyramidal tract and the nuclei of the third nerve are so near and above, the vein of Galen is in such intimate contact that a false passage will obviously have serious results. Moreover, an attempt to pass a sound blindly by palpation could scarcely be successful.

In the surviving patient in which the tube was inserted into the aqueduct there are no disturbances. It is now over a year since the operation. His movements are entirely without ataxia. He can hold up his head and walk with no sign of staggering gait or loss of equilibrium. He is talking both English and Norwegian quite freely but it is too soon to predict the final outcome.

SUMMARY AND CONCLUSIONS

1. Cicatricial stenosis of the aqueduct of Sylvius is the most frequent lesion in congenital hydrocephalus (about 50 per cent), and is found in a large percentage of cases of hydrocephalus occurring in infancy and early childhood. It may occur (though rarely) in adult life.

2. Hydrocephalus *always* follows occlusion of the aqueduct. The third and both lateral ventricles progressively dilate. The fourth ventricle, being posterior to the obstruction, does not enlarge.

3. In the gross, the occluded aqueduct appears to be replaced by a fibrous tissue which microscopically is neuroglia. Microscopic remnants of the aqueduct are usually but not invariably found.

4. The stenosis may occupy the entire length of the aqueduct, or varying parts; it may be only a thin even transparent membrane. Again, the stricture may be only partial.

5. Strictures of the aqueduct of Sylvius can be diagnosed and accurately localized. The indigo-carmine test will indicate that an obstruction is present; ventriculography will be the means of precisely locating the obstruction.

6. Spontaneous relief is not possible. Surgical attempts to drain the fluid from the third ventricle to the exterior of the brain have all proved futile. The openings invariably close and the fluid cannot absorb in the subdural space.

7. A surgical procedure is suggested which is directed toward the cause. A new aqueduct of Sylvius is constructed; a tube is left in place for 2 to 3 weeks. It is hoped the epithelium will regenerate and establish a new canal.

8. This operation has been performed on 2 cases, both recovering from the operation. One patient died of pneumonia several weeks later, the second seems well 1 year after the operation.

COMPRESSION FRACTURE OF THE VERTEBRAL BODIES WITH DELAYED SYMPTOMS (KUEMMEL'S DISEASE)

With Report of Seven Cases

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THE condition under discussion may not be familiarly known under the above title, but as a clinical entity it deserves, we believe, more emphasis and due recognition to the man who first gave it a clear description. This disease, which is perhaps more frequently seen in neurological than in orthopedic clinics, is characterized by the following features: spinal injury, with temporary symptoms of short duration and no local evidence of diagnostic importance, and subsequent delayed symptoms of pain, disability, and local signs of bony injury, especially kyphos.

In 1895, Kuemmel presented 5 cases of this type of spinal lesion with a discussion of the characteristic symptoms. In his series the injury was usually the result of a fall. Local pain was referred to the dorsal spine. The injury was not usually of such a character as to present signs of spinal cord lesion. The essential features at the first observation were pain, more or less localized over some point in the spine, limitation of motion of the type seen in muscle injury, and a disability period lasting perhaps but a few days. The subsequent history, however, characterizes the type of lesion. At a later period, varying from weeks to months, without history of a second injury of like nature, the patient develops pain in the back at the site of the former pain with increasing disability. On examination there will be found a localized tenderness over the spinous processes at the point of previous injury, with more or less marked local prominence of one of the spinous processes. This latter marks a point about which there is some limitation of motion. Kuemmel was inclined at first to attribute this condition to a traumatic osteoarthritis of the spine, but later came to consider it probably a type of fractured spine. The balance of his report considers the treatment—appropriate fixation over a long period.

Henle believed the condition due to a traumatic spondylomalacia. Shede stated that it might appear in fracture of the spine, and Kocher, Trendelenburg, Oberst, and E. Fraenkel considered it as a type of compression fracture of the vertebral body.

Since the first description the same type of case has been occasionally mentioned, but not until the X-ray had been developed and the technique improved to a fine point have we been able to check this syndrome with the actual organic lesion which seems to be the basis of all of these cases.

Even in the medical literature of the past 5 years no special mention is made of this delayed syndrome. The journals do include cases of compression fracture of the spine that are not associated with spinal cord symptoms.

Japiot, in 1914, reports 2 cases of fracture of the fifth lumbar, causing no cord symptoms. Such a fracture, of course, does not press on the cord proper but he calls attention to the fact that diagnosis is often made late, and therefore X-ray examination must not be omitted in spinal injury even without cord signs. He cautions against the part played by spina bifida in such injuries, and the relation of such cases to accident insurance.

Sever, reporting 8 cases, calls attention to the latent character of the symptoms in some spinal fractures. To illustrate with 1 case from his series, the patient injured in May, and confined to bed for 11 days, went to work the following August, but fracture was not diagnosed until October. Sever, reporting another series of 7 cases, shows that in all cases, X-ray examination was delayed, and the diagnosis not made until from 3 months to 2 years later. The most frequent site is the twelfth dorsal and first lumbar, and he appends 4 more similar cases.

Sharpe, reporting 4 cases, says they were all diagnosed late, and that no early X-ray

examination was made. He warns against the danger to the patient of a late diagnosis.

Spalding, quoting Elsberg, says that late cord symptoms are due to callus and can be relieved by laminectomy.

Allen reports 2 cases without cord injury but not of the delayed symptom type.

Stern emphasizes the importance of an X-ray examination within the first week.

Roberts cautions against the danger in undiagnosed cases and the necessity for a special X-ray technique.

It will be noted that most of the reports of the type of case under discussion assume that the diagnosis could have been made within the first few days following injury. That it has not, is partly due to the fact that the cases sometimes appear in one clinic at the initial injury and in another at the subsequent examination. We have reported this group of cases with the idea that perhaps this is not the only reason for failure of diagnosis at the time of injury. In support of this theory, we have 4 cases which indicate that the initial roentgenogram was negative for bony lesion since no active treatment was undertaken.

We, therefore, present the theory that there is a type of compression fracture of the spinal bodies which is apparently benign at first and gives no X-ray evidence of a bony lesion, but in which, at some later period, definite bony changes develop, and the diagnosis can be easily made by certain distinctive signs including the typical X-ray picture.

If we are right in believing that such fractures exist, then we may assume that there must be such cases included in the long list of traumatic neuroses and "railway spines" that are so frequently found in our large clinics. And in like manner the failure of diagnosis involves a large problem in the accident insurance relation to such cases.

These cases are presented in the hopes that some discussion may arise which will settle this problem of spinal fracture with delayed symptoms and signs. Obviously, in 1895, when Kuemmel described the type, no X-ray was to be used. And even in the last few years the technique for good definition in spinal injuries is only beginning. One of our cases X-rayed in 1912 could well have shown pathology at that time with our present technique. Also it may be argued by those familiar with the varying brand of X-ray skill exhibited in the army hospitals, that the cases referred to later were simply missed at the first observation. There will also be those who think that in the event of a primary negative X-ray, such cases as we present are simply examples of spinal tuberculosis, giving a history of trauma, as we so often see. In defense of our belief in this type of fracture, we can only say that the X-ray plate and the clinical picture is not that of tuberculosis. Photographic prints of these plates for publication with this report were purposely omitted. The difficulty of reproducing the detail of the original plate will naturally lay us open to suspicion by the advocates of Pott's disease as an explanation. We may only say that the subsequent history of our cases, and the absence of any tendency to abscess formation, seems to us to point against tuberculosis. Henle's idea of spondylomalacia is offered without comment.

To us there remain two facts to face: either we still lack finesse in X-ray technique or fail to use it in our diagnosis; or there remains a type of spinal lesion of the nature described under our title.

In regard to the prognosis of such fractures, we strongly urge the earliest possible diagnosis. This would include frequent examinations, physical and X-ray, for the weeks or months following the injury. Such a procedure might give us the first evidence of the coming bone destruction and afford us, by proper treatment, a chance to ward off actual collapse of the fractured centrum. If such observations were obtained, further light might also be shed on the pathology in these cases. The final prognosis will surely depend on the time at which diagnosis is made and treatment begun. Under our observation, even the cases which have gone to collapse of the centrum have been restored to a point where symptoms have disappeared and signs only remained.

In regard to the treatment of such cases we have little to say. We believe it imperative to include a careful spinal roentgeno-

gram in all cases of back injuries within the first week of initial injury. And then we should give a guarded prognosis in case the roentgenogram proved negative. The treatment directed to the spine will vary somewhat, but the rule will be adequate fixation over an extended period. This has been accomplished in some clinics with satisfaction by the use of plaster. Some authors, in the recent literature on the subject of compression fracture, advocate bone-grafting. Those who propose and practice this do so because they believe there is danger in allowing the patient to go without positive fixation. They call attention to some cases that seemingly progress to cord injury under the usual forms of treatment.

The following cases illustrate the type that may be expected to follow the rule in Kuemmel's syndrome.

CASE 1. Private H. Examined for discharge from the army. Complains of pain in the back, referred around the right side of the chest along the lower ribs. Gives the following history:

While on duty in France the patient jumped into a shell hole and experienced sudden pain in the back. He felt at first that he was paralyzed in both legs. He lay quiet in the shell hole for several hours and then, under cover of darkness, found he was able to crawl out, back to his own lines. He was not particularly conscious of any weakness in the legs upon arriving at the hospital. He had an X-ray examination of his spine, of which he heard no report. He was returned to a convalescent camp in 8 days, but never returned to full duty because of continuous pain in the back. He had no local treatment to his spine following the injury. Present examination five and one-half months following the injury shows a kyphos at the level of the eleventh dorsal vertebra slightly to the right of the mid-line, which is tender on pressure. Spinal motion is limited for several segments above and below this point. There is distinct muscle spasm. No areas of anæsthesia could be demonstrated; there is hyperæsthesia along the course of the twelfth intercostal and first 2 lumbar nerves on the right side. No other neurological signs are present. X-ray examination reveals a compression fracture of the body of the eleventh dorsal vertebra.

CASE 2. Serg. C. When examined for discharge from the army the patient complained of pain in the lower spine which he states is the result of an injury received 4 months before while on machine-gun drill. He fell while making an emplacement. At that time he was sent to the base hospital where he was confined in bed for 4 days. No local treatment was applied. An X-ray picture was taken. He was told that nothing was found (the report is not available). He was returned to full duty on the sixth day following injury. He has complained of some pain in the back ever since, and has repeatedly reported to the infirmary on account of the pain. Examination shows at the present time, January 24, 1918, a tender kyphos at the level of the second lumbar vertebra, with referred pain extending around the body in front along the course of the spinal nerves. This is aggravated by forward bending; there is limitation of all spinal motion for two segments above and below this point. On one of two examinations a rather noticeable muscle spasm was also noted. X-ray examination at this time shows typical compression fracture of second lumbar vertebra. Patient retained for further treatment.

CASE 3. Mr. R. J. P., student. In 1912 the patient had an injury to the spine, with no special neurological signs; he was confined to bed for 7 days and was then able to resume his normal work. He had an X-ray picture taken at that time, the plate of which has been lost, but the record is retained and reports no evidence of bony injury. As the symptoms did not completely clear up at that time the patient's physician advised a fixation dressing which he wore for several weeks. He was advised that in spite of the X-ray finding, a fracture of the spine may have occurred, but at the end of treatment all symptoms had disappeared. He came to our attention November 10, 1919. He is having no particular difficulty, but is unable to follow the usual gymnasium exercises because of aching pain in the lower spine on excessive forward and lateral bending. Examination shows a loss of the lumbar curve, with a prominence of the twelfth dorsal and second lumbar spine. There is some tenderness over the bony prominences. X-ray examination shows "a typical compression fracture of the body of the third lumbar vertebra. No other portion of the spine appears to be injured."

CASE 4. Mr. H. K., age 36. First seen November 4, 1919. He gives a history of injury to his spine December 17, 1918. The patient states that while in army service his back was injured and he was confined to the hospital for 6 days. An X-ray was taken at that time but he did not see the report. He was told by his medical officer that there was nothing unusual in the X-ray. No special treatment was applied to the spine at that time. He was returned to light duty with no especial disability. He has been bothered for some time by pain in the back. Examination of the spine shows a posterior curvature in the lower dorsal region. To the left of the twelfth dorsal spine is a prominence of bone slightly tender, spinal motion is not noticeably limited. X-ray examination shows "the intervertebral line to be maintained." The body of the eleventh dorsal vertebra corresponds closely with the upper border of the twelfth, apparently impacted into it, and some overriding of the eleventh in the posterior border. There is apparent narrowing of the body of the twelfth dorsal. There is consider-

able sclerosis of the intervertebral discs, both above and below the twelfth dorsal.

CASE 5. Mr. E. R., age 49, entered the hospital for injury to both wrists and the left chest wall in front. He also complains of some pain in the lumbar region, which has been present for some weeks, and seems to be aggravated by the recent injury. Examination shows no bony lesion in either wrist or the chest wall. An X-ray picture of the spine reveals "an old spinal arthritis with a compression fracture of the body of the fourth lumbar vertebra." Upon examination of the spine there was tenderness on palpation over the third and fourth lumbar vertebræ. A very slight kyphos is noted slightly to the left of the mid-line. Spinal motion is limited in this area. Upon further questioning the patient gives a history of injury, about 1 year ago, to the lumbar spine, following which he was confined to bed for 4 days. He has had no neurological signs at any time; no X-ray examination was made at first injury. The patient believes that the pain in the back which has occurred recently was started by heavy lifting. All other examinations negative.

CASE 6. Mr. E. H., age 44, first examined January 20, 1920. He gives the following history:

Twenty-one years ago he fell 36 feet, striking on his shoulder. Both clavicles were fractured. Immediately after injury there was some difficulty in control of the bladder and bowels; this quickly cleared up; patient was in bed 3 weeks, then used crutches for 6 months. In the meantime he had osteopathic treatments. Since discarding crutches, the patient has used a cane at intervals, when his back is most painful. He is able to follow his trade of illustrator. He states that several months following the injury he began to notice a knuckle over the spine. Examination shows a kyphos at the region of the eleventh or twelfth dorsal spine. His present pain is referred around the body along the course of the spinal nerves. There is limitation of motion in all directions above and below the point of kyphos. No immediate tenderness over this point. X-ray examination shows "what appears to be the end-result of a compression fracture of the twelfth dorsal vertebra. The intervertebral disc above is distinctly narrowed, while below it is of normal width." Wassermann negative. There is evidence of an old apical pleurisy on the left side. Appropriate treatment advised.

CASE 7. Mr. H. K., age 59, injured his back in a railroad accident 9 months ago. He had no serious symptoms at the time although he was confined to bed for a few days. There was no paralysis or disturbance of bladder function. X-ray examination was made immediately following the injury.

Examination, January 15, 1920. The patient complains of a painful back. He is able to be up and around but is refraining from work, awaiting compensation for his injury. A kyphos is present at level of twelfth dorsal, slightly tender to pressure; limitation of motion for two or three segments above and below this area in all directions. Knee-jerks are rather active. A slight ankle clonus is present on the right. Sensory changes were not determined. Wassermann is negative. X-ray examination shows "definite evidence of a compressed fracture of the twelfth dorsal vertebra, with typical slight kyphos, anterior bridging also seen between the first and second lumbar vertebræ. Body of the twelfth is wedge-shaped. The extent of the bridging suggests an associated arthritis, either prior or subsequent." Patient has had no special treatment to produce fixation of the spine. Appropriate treatment advised.

CONCLUSIONS

1. Compression fracture of the spinal bodies without cord symptoms is frequently undiagnosed, or incorrectly diagnosed at the time of injury.

2. A negative finding by the X-ray at the period of initial injury is not proof positive against fracture.

3. Symptoms referable to the fracture may not occur for some time after injury.

4. At this later period the signs and X-ray findings are all in keeping with a diagnosis of compression fracture of the spinal bodies.

5. The exact sequence in the pathology leading to such a diagnosis is not understood.

6. The prognosis will depend on the time of diagnosis and the institution of proper treatment.

7. The treatment is that of compression fracture of the spine and the cases respond under such treatment as do the more familiar types of compression fracture.

REFERENCES

KUEMMEL. Deutsche med. Wchnschr., 1895.
OPPENHEIM. Text Book of Nervous Diseases.
ELY. Am. J. Orthop. Surg., 1914, October.
ALLEN. F. O. Ann. Surg., 1916, lxiii, 757.
BRACKETT, MIXTER, and WILSON. Ann. Surg., lxvii, 513.
ELSBERG. Am. J. Surg., 1914, January.
IDEM. J. Am. M. Ass., 1916, July.
JAPIOT, M. D. Lyon méd., 1914, cxxii, 977.
NEWTON, ALAN. M. J. Australia, 1915, i, 164.
ROBERTS, P. W. Surg., Gynec. & Obst., 1916, xxii, 198.
SEVER, J. WARREN. Surg., Gynec. & Obst., 1916, xxii, 338; Boston M. & S. J., clxxiv, 606.
SHARPE, NORMAN. J. Am. M. Ass., 1918, lxxi, 1362.
SPALDING, C. B. Am. J. Surg., 1918, xxxii, 245.
STERN, WALTER F. Cleveland M. J., 1917, xvi, 251.
HARTWELL. Colorado Med., 1919, xvi, 79-83; Am. J. Orthop. Surg., 1916, xiv, 82.
PEMBER. Ry. S. J., 1917, xxiii, 390.

PRE-OPERATIVE PREPARATION OF DIABETIC PATIENTS AND THEIR SUBSEQUENT TREATMENT

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IN those patients in whom operative interference is not a matter of extreme urgency, it is advisable that diabetic individuals undergo a course of preparation for the surgical procedure. Of course, if the complaint is such that immediate incision is imperative, all other consideration must give way, and the patient should be forthwith operated upon. For, to the diabetic there are many dangers lurking when operation is decided upon by the surgeon. There is the danger of a superimposed postanæsthetic acidosis or a possible dormant or active acidosis. The tissues do not heal promptly; and there is the risk of suppuration and prolonged drainage with the anæmia, emaciation, etc. The upset of the general metabolic exchange and the derangement of the gastro-intestinal system are not conducive to proper carbohydrate or fat oxidation, and add to the danger of acidosis. The fever, the extra load upon the work of the kidneys, the possible constipation and intestinal putrefaction—all add their little to the danger of lessened alkali reserve.

It is possible, quite frequently, by preparing the patient for operation to eliminate a number of their great perils, and thus aid the patient on his road to recovery from the surgical condition.

The patient's degree of acidosis should be promptly determined. This can be done by several methods. The carbon-dioxide combining power of the blood plasma as determined by the apparatus of Van Slyke gives excellent results. Normally the figure obtained is about 60 per cent. In cases of lessened alkaline reserve, the volume of carbon-dioxide with which the plasma can combine is much lessened, figures under 40 per cent being quite dangerous. The carbon dioxide content of the alveolar air, as determined by the Fredricia's instrument, or the carbon-dioxide tension of the alveolar air as measured by the apparatus of Marriott also give much information. In the urine one should look for the ketone substances—acetone, aceto-acetic acid, and beta-oxybutyric acid. The formalin titration quotient of the urine, according to the process of Henriques-Sörensen will also determine the extent of the acidosis.

Now, it must be understood that in diabetes[1] the acidosis is of the ketone substance type; that is, the presence of the acetone substances is the cause of the diabetic acidosis. These toxic substances are produced due to a disturbance in the *fat* oxidation of the body, due to a lack of sufficient combustion of carbohydrates. In normal individuals, in the presence of the heat of carbohydrate oxidation, the fats are broken down to the four carbon acid (butyric acid), and then very promptly to carbon dioxide and water. In diabetic patients, due to the absence of a sufficient volume of carbohyrate combustion, the fats after being decomposed to the butyric acid stage, begin to smolder and smoke, and become very slowly oxidized, with the formation of intermediary products, which are ketonic in nature and toxic in their effect.

If we find that a state of ketosis exists in our patient, the most obvious treatment should be directed to the curing, if possible, of this condition. Recourse must be had to the following principles: (1) The amount of fat intake must be reduced to a minimum, and (2) the carbohydrate oxidation must be stimulated, because of its antiketogenic powers.

The patient is, therefore, put upon a diet extremely poor in fat and rich in vegetables and proteins, with the addition of a cereal which adds to the carbohydrate content. If absolutely necessary, some bread may be added. Sometimes several doses of whiskey, diluted with water, increases the body oxida-

[1]Rosenbloom has described a certain type of diabetic coma due to non-ketone subtances.

tive processes and exerts an antiketogenic influence. It is not advisable to administer sodium bicarbonate, for several reasons. Clinically, sodium bicarbonate seems to have certain deleterious influence. It very often is the final propulsion that induces coma. I have never seen a case of diabetic intoxication that was saved by the administration of the bicarbonate. I have, however, seen many cases of diabetes in which coma was induced immediately after the injudicious use of the sodium salt. Frequently, the acetone substances lie dormant in the tissues of the body, in union with some protein or amino acid group. The sudden flushing of the system with the sodium bicarbonate serves to split off the ketone substances with the immediate overwhelming of the vital centers.

It has been my experience that it seems to be the routine of the surgeon's practice to advise liberal administration of the alkali, either by mouth, or preferably (to him) by the intravenous route, to his diabetic patients. He then feels as if he has insured his patient against an impending acidosis state. In the average operator's practice, no determination is made of the necessity for such alkali treatment. He administers the bicarbonate as a matter of routine, because it is *comme il faut*. Joslin very properlystates: "I believe that often a patient threatened with diabetic coma is sent into actual coma by the careless administration of alkalies." Another danger of the ingestion of large quantities of alkalies, is the extra work thrown upon the kidneys in the excretion of the large amounts of acids, so that the renal apparatus may cease to act. I have seen quite a number of diabetic patients, who, upon the administration of bicarbonate, develop marked œdema of the extremities, back, and face, which was relieved only by the interdiction of the use of the bicarbonate.

The constant excretion of acids from the body is a great drain upon the mineral reserve of the organism, and as Van Slyke has pointed out, it is not only the acid remaining in the body which may do harm, but also those excreted in the urine by the removal of the bases. "It is by no means, therefore," writes Joslin, "an unmixed blessing to favor the removal of acids from the body by the use of alkalies."

Dr. Nellis B. Foster has recently reported before the surgical section of the New York Academy of Medicine that he administered in a case of diabetic coma two doses of 10 grams sodium bicarbonate triturated in 10 cubic centimeters olive oil (sterile) subcutaneously at an interval of 8 hours. He later informed me that he did not save the patient but that he observed that the urine turned alkaline. It seems, therefore, that in this case, the patient died with an alkaline urine, without having derived any benefit therefrom.

A brief résumé of the rules to be followed in the treatment are:

1. Keep the bowels open, preferably by enemata, in order to avoid diarrhœa and the consequent drainage of alkaline salts from the body;

2. Administer fluids in liberal amounts—a glass of liquid every hour or hour and a half;

3. Increase the tolerance for carbohydrates;

4. Avoid substances that induce the formation of the acids—such as fats, and, ofttimes, proteins;

5. Administer substances which favor the combustion of the ketones, as for example, oatmeal, levulose, alcohol, etc;

6. Do not prescribe alkalies.

Having made certain that the patient is not on the verge of acidosis, or if he is in a state of acidosis, having (by the various measures above enumerated) rid the body of the acid substances, one can, by following either the plan of Allen, or by a modified starvation diet, reduce the glycæmia without at the same time decreasing the alkali reserve of the blood. The patient may now be operated upon.

The surgeon must always remember that lipin-solvent anæsthetics—chloroform or ether—induce even in normal individuals a post-anæsthetic acidosis. Diabetic patients should, therefore, not be operated upon under these anæsthetics. Nitrous oxide should be used in preference to local anæsthetics, which may induce shock. I have seen many major surgical operations performed on diabetics

under the influence of nitrous oxide. The operation should be performed as rapidly as possible, and as radically as desired, in order to avoid the necessity for re-incision, sloughing, etc.

In the after-treatment, the glucose tolerance should be constantly increased, slowly but surely. At the same time strict attention must be paid to the state of alkali reserve of the blood. It will, I think, never be found necessary to administer the sodium bicarbonate to such patients. A judicious use of the carbohydrates and the reduction of fat intake will be quite sufficient to check the development of the ketone substances.

The use of caffeine in the form of black coffee has been recommended in the dietetic management of diabetics. Patients get as much as seven cups of strong black coffee daily. I believe this is inadvisable. It seems to stimulate the glycolysis of the body, and experimentally, it is known that the caffeine administration induces a hyperglycæmia and glycosuria If a stimulant is necessary, one should resort to the other ones in the doctor's armamentarium. Caffeine has also the disadvantage of keeping the patient awake, and inducing him to worry and be restless.

In all cases, if I may suggest it, the surgeon should consult with an expert medical man in his care of the diabetic. The dietetic daily variations must be closely scrutinized by a man conversant with the significance of the various food ingredients. It is altogether too frequent an occurrence for the surgeon to request the dietitian, who may not be a physician, to regulate the diet for his diabetic patient. The laboratory should be frequently called into consultation to determine the state of the glycæmia, and the presence or absence or degree of acid intoxication.

It has been my experience that it is advisable to administer large quantities of calcium salts to diabetic individuals. The reasons for this have been enumerated elsewhere.[1] In certain cases it is recommended that this be given intravenously in doses of 20 to 50 cubic centimeters of an eighth molecular solution of calcium chloride in water. I usually advise patient to take 10 grains of calcium chloride three times daily, after meals.

[1] Kahn and Kahn. Arch. Internal Med., 1916, xviii, 22.

PATHOLOGY OF THE KNEE-JOINT IN RELATION TO X-RAY FINDINGS

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While pathological conditions found in osseous tissue may vary greatly, and this is especially true of lesions of the knee joint, the X-ray representation of such conditions discloses in the final analysis but a few elementary findings, the most striking of which are hypertrophy, atrophy, ulceration, and sequestration of bone. Were it not, therefore, for the mass of evidence secured from a careful study of the history of the case and from a careful clinical examination, the X-ray examination would give very little help, indeed, in the diagnosis of bone diseases. There are, however, certain conditions in which the X-ray is undoubtedly the decisive element in the diagnosis. The cases described and mentioned are taken from the material of the orthopedic service of the University Hospital, Iowa City.

In traumatic arthritis without gross injury to bone, we found that no definite changes could be seen in the structures of the joints until the subacute or chronic stages were reached. At this time slight atrophy began to appear about the joint surfaces and the contours denote increased thinning out of the joint cartilage. Such findings were also observed in repeated traumatism, as habitual subluxation of the knee, except that in growing children any postural changes in the knee-joint soon showed structural changes under the law of functional adaptation. Such findings were regularly observed after contoural changes in the bones above or below the knee-joint. They consisted essentially in condensation in the bony structures at the deformity, that is for instance, in cases of knock-knee, at the outer side, and in cases of bow-legs, at the inner contour of the leg. Changes in the trabecular system will also occur and are entirely subservient to the laws of statics.

This point is most beautifully illustrated in rachitic deformities of the knee-joint, as genu valgum and genu varum, and it should be borne in mind also that such structural changes following Wolfe's law will be encountered in any condition in which changes of the mechanical forces are at work and, therefore, may be looked for also in fracture deformities of the knee-joint. Often such changes in the arrangement of the bony trabeculæ are, after a certain length of time, the only evidence of previous fracture in growing children. The knee-joint and its bony constituents is an excellent object for the study of the law of spontaneous rectification of deformity and here again rachitic conditions are more illustrative than others by virtue of their frequency, the degree of the deformity, and the comparative rapidity of anatomical repair.

In the knee-joint, chronic inflammatory conditions of the synovial type resemble very much, in the X-ray examination, chronic traumatic effusions except that the inflammatory condition shows more extensive regional atrophy of the bone ends. The cartilage also becomes thinned out and atrophic. The contour of the joint outlines often indicates ulceration. Such ulceration predisposes to the melting and lifting off of cartilage in patches and the subsequent erosion of the denuded bone. A considerable region of atrophy accompanies this picture and is supposed to be more extensive in some conditions and less in others. It is difficult to differentiate chronic infectious conditions from rheumatoid or infectious arthritis or arthritis from gonorrhœal or pneumonic sources. A case of very advanced degree of infectious arthritis came under observation in 1916 and was treated until his death in October, 1919.

Most of the pathological changes were found in the ends of the long bones, especially in the knees. The shaft of the femur, while appearing normal in contour, showed exceedingly soft, friable bone, which could easily be crushed with the fingers and very easily be

Fig. 1. Rheumatoid arthritis. Spontaneous subluxation of the knee.

cut with the knife. On longitudinal section the entire bone was filled with a mass distinctly yellowish in color which reached from the shaft of the bone to the epiphyseal end. The most striking change in the X-ray findings was an extreme degree of atrophy with the outlines of the bone fairly unimpaired.

In infectious arthritis of the knee-joint due to gonorrhœa, the changes found in the X-ray are more or less the same except for a varying degree of regional atrophy.

Atrophy is also an important element in tuberculous lesions of the knee-joint and is seen in association with either no bone destruction or only superficial ulceration of the surface of the cartilage. It is often difficult if not impossible to differentiate in the X-ray tuberculous arthritis from arthritis of any other kind. Only in cases of young children in which an initial bone focus can usually be located in the lower end of the femur or in the upper end of the tibia, is it as a rule possible to make a differential diagnosis from the X-ray picture. Again, as regards bone destruction we have often found it difficult in the study of the X-ray picture to differentiate between this condition and syphilis and gummatous destruction.

Fig. 2. Infectious arthritis, showing loss of joint cartilage with fibrous adhesions.

In a small number of cases of bone abscess in the femur, one or two were found located at the lower end of the shaft of the femur near the epiphyseal line, and these cases were well outlined and characterized in the X-ray findings.

Of chronic traumatic conditions of the knee-joint, the following groups were studied in the X-ray:

Dislocated semilunar cartilage, 3 cases; osteochondritis dissecans, 3 cases; rice bodies, 3 cases.

Dislocated semilunar cartilage will not give any X-ray evidence except when incrustated. Incrustated pieces of cartilage show complete separation and, therefore, form free bodies. None of the cases of dislocated semilunar cartilage showed any positive X-ray evidence, and the diagnosis was necessarily dependent upon the clinical evidence.

The three cases of osteochondritis dissecans all showed characteristic pictures of sequestration at the outer border of the inner

Fig. 3. Tuberculosis of the knee, showing a smoky appearance or cloudiness.

Fig. 4. Syphilitic arthritis. Honeycombing of lower epiphysis of femur.

condyle of the femur. All cases were operated upon.

The cases of rice bodies showed the definite picture of hazy outlines of small round bodies in the X-ray as described by Henderson.

Of chronic osteomyelitis of the knee, 21 cases were observed. With the extension into the joint of the osteomyelitic process, the joint changes proper become very evident in the X-ray findings. Destruction and absorption is very marked but as contrasted with tuberculous osteomyelitis, atrophy is very limited and evidences of periosteal activity of the periphery are plentiful. Many of these cases were, of course, indefinite and were even subject to error in diagnosis, but in a number of others the principle of bone destruction without regional atrophy and the periosteal hypertrophy of the bone was very characteristic.

Charcot's joint was observed in 3 cases and studied in the X-ray picture. The X-ray shows extraordinary bony changes. Above all there is the great irregularity in the outlines of the contours, production of exostosis and bone spicula, and lipping of any degree or description. The bony activity seems to be entirely unrestrained. This combination of destructive processes, associated with a

Fig. 5. Osteochondritis dissecans showing a free body of osseous substance detached in the joint.

Fig. 6. Sarcoma of the lower end of the femur — periosteal juvenile type.

Fig. 7. Sarcoma of femur — periosteal type.

great deal of bone production together with the absence of any inflammatory reactive bone production is of great weight in the diagnosis of Charcot's joint in the knee. Of course, it is the physical examination upon which the diagnosis is based, especially the enormous enlargement of the joint, lack of lateral stability, great irregularity of outlines, production of new mass of bone, and above all the utter absence of pain.

Bone cysts are rarely found in the knee-joint. Beck describes two cysts of the upper end of the tibia. Their appearance in the X-ray picture if present in the bone is quite characteristic, and they present themselves as well-defined uniform shadows. Solitary bone cysts are usually the product of osteitis fibrosa or rather, according to Barrie's investigation, the end-result of hæmorrhagic osteomyelitis; in rare instances, they seem to be true giant cell tumors although it must be emphasized that the finding of giant cells themselves is of no value in diagnosing giant cell sarcoma. One case of multiple cyst formation was studied in which the underlying condition was that of Paget's disease, osteochondritis deformans. In the X-ray picture the multiplicity of cysts, roughness and irregularity of outlines, and thinning out of the cortical bone are suggestive of this condition.

In many cases it becomes difficult to differentiate between this condition and that of sarcoma. In the central sarcoma of the shaft of the tibia, we find the disappearance of the bone structures, ballooning of the bony outlines, and finally penetration through cortical

Fig. 8. Complete osseous ankylosis following streptococcus infection.

bone, with unrestrained growth of the tumor. In the periosteal formation, the tumor growth will be mainly excentric as the mass perforates the periosteum and penetrates soft tissue. The tumor presents itself often as a cauliflower-like growth. Three cases of sarcoma of the tibia were studied.

In tuberculosis of the knee-joint, the different clinical types of this affection are fairly well represented by X-ray pictures. The synovial type of knee tuberculosis as found most often in adults will present within the outlines a smoky appearance of the granulation tissue together with fairly well preserved contours of the bone and with very marked secondary atrophy of the substance of the bone.

Ulceration of the joint cartilage can be readily seen in the X-ray. Cases with shortening, as in the majority of infantile and juvenile types, present the characteristic X-ray picture of bone destruction, honeycombing and at times sequestra. Considerable destruction of one or the other of the epiphyses very often produces a tendency to valgity or backward dislocation of the knee. The degree of regional atrophy of the bone end is always in keeping with the amount of actual destruction, but it is more dependent upon conditions within the joint itself. Twenty-five cases of this kind were studied in the X-ray picture.

Ankylosis resulting from inflammatory conditions were studied in 11 cases. Rheumatoid and gonorrhœal arthritis and tubercular arthritis very seldom lead to bony ankylosis. In osteomyelitis, however, especially in the very virulent types, true bony ankylosis is quite common.

Seven cases were observed in which ankylosis was absolutely complete, the structure of the femur being fused with that of the tibia both in anatomical outline and in texture, with no differentiation between the two bones. Ankylosis of this kind is quite common following a severe streptococcus infection. In other cases the degree of bony ankylosis was less and while there was bone formation from one bone to the other the architecture was not clear nor was the bony contact as complete as mentioned.

If one is to draw conclusions as to operative indications from X-ray findings in the cases of ankylosis of the joint, it is well to remember that ankylosis of the joint is more often actually present in the joint while not represented in the X-ray findings, and that in general the actual amount of fibrous ankylosis is usually in excess of that which is demonstrable in the X-ray picture.

This study is based on 106 cases which came under observation.

In conclusion it may be pointed out that the X-ray findings are only an aid in making a differential diagnosis between the different bone conditions, and it should be used only as a corroborative agent in making a positive diagnosis of bone and joint conditions.

I wish to acknowledge my indebtedness to Dr. Arthur Steindler, Professor of Orthopedic Surgery at the Iowa State University, for assistance and suggestions; also for the clinical material which has enabled me to write this paper.

BIBLIOGRAPHY

ANGLIN, R. H. Loose bodies in the knee-joint, with special reference to their etiology and growth. Brit. J. Surg., 1914, April.

BECK, O. Bone conduction in syphilis. Ann. Otol., Rhinol. & Laryngol., 1913, xxii, 1099–1109.

BECK. Arch. f. klin. Chir., 1903, lxxx, 1099; Am. J. M. Sc., 1901, cxxi, 666.

BINE, R. Syphilitic osteoperiosteitis. Calif. St. J. M., 1911, ix, No. 11.

BLAKE. Boston M. & S. J., 1906, civ, 261.

BLOODGOOD. J. Am. M. Ass., 1904, Oct. 15; Progressive Med. 1903, 191; ibid., 1904, 183; ibid., 1903, 275; Ann. Surg., 1910 iii, 145.

BOUSING. Separation of the descending process of the upper epiphysis in a boy. The Lancet, 1910, Jan. 15, 175.

BRACKETT, E. G., and HALL, C. L. Osteochondritis dissecans. Am. J. Orthop. Surg., 1917, xv, 79–94.

BRACKETT, E. G., and OSGOOD, R. E. The popliteal incision for the removal of joint mice in the posterior capsule of knee-joint; a report of cases. Boston M. & S. J., 1911, clxv, 975–976.

BROWN, P. Further consideration of roentgen diagnosis, luetic skeletal manifestations. Am. J. Roentgenol., 1914, i, No. 8.

CODMAN, E. A. Formation of loose cartilages in knee-joint. Boston M. & S. J., cxix, No. 16, 427.

COFIELD, R. B. Syphilis of the joints. Lancet-Clin., 1915, cxiii, No. 13.

COON, CLARENCE E. Bone and joint syphilis. Am. J. Orthop. Surg., 1915, xxiv, 211.

CORNER, E. M. Surgery of the knee-joint. J. Am. M. Ass., xiii, 1069.

DAVIS, G. G. Applied Anatomy. Philadelphia: J. B. Lippincott Company, p. 638.

DONOGHIE. Avulsion of tibial tubercle occurring in a girl of 13. Boston M. & S. J., 1903, cxviii, 840.

DUNLAP, J. The adolescent tibial tubercle. Am. J. Orthop. Surg., 1912, ix, 313.
ELMSLIE. Tr. Roy. Soc. Med., 1909–1910, iii, clinical section, 192; Brit. M. J.
ELY, I. K. Joint mice. Ann. Surg., 1915, January.
ENO, F. Report of a case of gumma or bony and cartilaginous tissue. Proc. Canal Zone M. Ass., 1912.
FRAUENTHAL, HENRY H. Syphilitic arthritis. Med. Rec., New York, 1906, lxix, 822.
FREIBURG, A. H., and WOOLEY, P. G. Osteochondritis dissecans concerning the nature and relations to formation of joint. Am. J. Orthop. Surg., 1910–1911, viii, 477–494.
GASK. Brit. J. Surg., 1913, i, No. 1, 49.
GOLDTHWAIT, PAINTER and OSGOOD. Diseases of the Bones and Joints, 1909.
GRAEF. Ztschr. f. orthop. Chir., 1915, xcv, 645.
GUSZMAN, J. Polyarthritis syphilitica acuta. Wien. med. Wchnschr., 1915, lxv, 185–193.
HALSTEAD. Johns Hopkins Hosp. Bull., 1904, xv, 262.
HAMMANS. Ann. Surg., 1912, Mar.
HEINECK, A. P. Joint bodies from within and without present in articulation otherwise apparently normal. Ill. M. J., 1915, Jan.; West Virginia M. J., 1915, 291.
HENDERSON, M. S. Loose bodies in the knee-joint. Am. J. Orthop. Surg., 1916, xiv, 265–280.
HIGGINS, W. H. Luetic arthropathies. Am. J. M. Sc., 1915, cl, Nov.
JOHNSON. Surgical Diagnosis. 1910, iii, 535.
JONES, R. Notes on derangement of the knee. Ann. Surg., 1909, i, 969–1001; Disabilities of knee-joint. Med. War Manual No. 4. Military Orthop. Surg., Philadelphia: Lea & Febiger, 1918, 87–104.
KARSNER, H. T. Congenital syphilitic osteochondritis. Proc. Path. Soc., Philadelphia, 1910, n. s. xiii, 54.
KUTH, J. R. Early congenital bone lues. Arch. Pediat., 1915, xxxii, 244–265.
LECONTE. Boston M. & S. J., 1911, clxiv, 771.
LEDIARD. Tr. Roy. Soc. Med., 1910–1911, iv, clinical section, 132; Lancet, 1911, clxxx, 736.
LEHMAN, J. F. Clinical case of syphilitic condition of the patella. West Canadian M. J., Winnipeg, 1913, vii, 246–249.
LETT. Lancet, 1910, iii, 1202; Tr. Roy. Soc. Med., 1909–1910, iii, children, 98.
LORD, JOHN PRENTISS. Multiple loose bodies in knee-joint. J. Am. M. Ass., 1904, May 7, 1211.
LOVETT, R. W. Bursitis of the deep pretibial bursa with a report of cases. Med. & Surg. Report. Boston City Hospital, 1897, viii, 345.
LOW, WARREN. Tr. M. Soc. Lond., 1910, xxiv, 414; ibid., 1913–1914.
MERCER, A. C. Clinical remarks on cases of congenital syphilis and rickets. Buffalo M. & S. J., 1892–3, xxxii, 411–417.
MOORHOF and JONES. Lancet, 1905, i, 146.
MORGAN, J. H. A discussion on congenital syphilitic manifestations in bones and joints. Brit. M. J., 1895, ii, 697–700.
MULLER. Univ. Penn. M. Bull., 1906, Sept.
MURPHY. Surg. Clinics John B. Murphy, 1913, Aug.
O'REILLY, J. A. Joint syphilis. J. Missouri St. M. Ass., 1915, xii, No. 3; Joint syphilis in children. Am. J. Orthop. Surg., 1915, xii, No. 4; Joint syphilis. Ibid., 1914, xi, 431.
OSGOOD, R. B. Boston M. & S. J., 1903, Jan. 29, 114.
OWEN, S. A. Syphilitic diseases of joints and bones in childhood, their differential diagnosis from the medical standpoint. Med. Press & Circ., Lond., 1913, n. s. xcvi, 531–535.
PARTRIDGE, A. A. H. Unusual joint changes in a child, the subject of inherited syphilis. Rep. Soc. Study Dis. Child., Lond., 1902–3, iii, 23–233.
PAUS. Internat. Abstract. Surg., 1913, Dec. 635.
PHEMISTER, D. B. Necrotic bone and the subsequent changes which it undergoes. J. Am. M. Ass., 1915, Jan. 16, 211.
PREISER, G. Ueber Knochenveraenderungen bei Lues Congenita tarda. Fortschr. a. d. Geb. d. Roentgenstrahl. 1908.
PRINGLE, J. H. Avulsion of the spine of the tibia. Ann. Surg., 1907, xlvi, 169.
RIDLON, J. Osteochondritis dissecans. J. Am. M. Ass., vol. xi, 1777.
ROTH, P. B. Loose bodies in the knee; special reference to their etiology and growth. Brit. J. Surg., 1914–1915, 650–664.
ROUGHTON. Lancet, 1909, i, 973.
SAUNDERS, A. O. A case of syphilitic periosteitis. West London M. J., 1910, xv, 43.
SCHILLER. Muenchen. med. Wchnschr., 1909, No. 36, 1869.
SENDDER. The Treatment of Fractures. 1916, 8th ed., p. 509.
SHEDE. Deutsch. med. Wchnschr., 1886, xiii, 389.
SHOOP, F. J. X-ray in differential diagnosis between gumma and osteosarcoma. J. Dermat. & Genito-Urin. Dis., 1912, xvi, 355.
SILBERMARK. Deutsche Ztschr. f. Chir., 1904, lxxv, 290.
SIMMONS. Ann. Surg., 1911, Jan.; Boston M. & S. J., 1912, ix, 563; 1913, xviii, 637–645.
SKILLERN, P. G., JR. Syphilis in etiology of fibrous osteitis. Am. J. M. Sc., 1913, cxlvi, 531–535.
STEIN, H. C. Syphilitic arthritis. Med. Record, New York, 1915, lxxxviii, 472.
STEWART. Ann. Surg., 1911, iii, 699.
STIMSON. Fractures, etc., 1907, p. 382.
STRUMPF. Deutsche Ztschr. f. Chir., 1912, cxvi, 417.
STUDENY. Arch. f. klin. Chir., 1910, xcii, 495.
SUTHERLAND, G. A. Some bone lesions of congenital syphilis. Brit. J. Child. Dis., Lond., 1908, v, 52.
TAYLOR, ROBERT W. Syphilitic lesions of the joints in hereditary and acquired infection. Med. Record, New York, 1906, May 26, 620.
THOMPSON, A. A marked example of Schlatter's disease. Edinburgh M. J., 1909, ii, 250.
TROELL, A. The origin of free bodies in the knee with special reference to osteochondritis dissecans. Arch. f. klin. Chir., 1914, Aug., No. 2.
TRUSLOW, W. Hereditary syphilis in bones and joints. Long Island M. J., 1914, viii, 299.
TUBBY, A. H. The bone and joint lesions in hereditary syphilis. Brit. J. Dis. Child., Lond., 1908, v, 49–52.
WEIL, S. Beitr. f. klin. Chir., lxxviii.
WHITMAN, R. Orthopedic Surgery, 1910, p. 453; Ann. Surg., 1904, xl, 121.
WHITNEY, JAMES G. A statistical study of syphilis as seen in the Out-Patient Department of the University of California Hospital. J. Am. M. Ass., 1915, Dec. 4.
WINSLOW. Symmetrical inflammation of the epiphyseal beak of the tibia. Ann. Surg., 1905, Feb., 278.
WOLLENBERG. Deutsch. Ztschr. f. orthop. Chir., 1909, viii, 350.
YOUNG, J. K. Orthopedic Surgery, 1910, p. 453.

FIBROMYOMA OF THE MESENTERY

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THE infrequent occurrence of solid tumors of the mesentery, particularly those of the more highly specialized tissues, leads us to report this case of fibromyoma.

Case A296629, Mrs. O. F., age 25, came to the clinic, November 14, 1919, because of constipation and menorrhagia. One brother had had epilepsy. The patient's menstrual periods had always been irregular, coming every 4 to 6 months, lasting 2 to 3 days, scanty, and associated with severe pain. She had been married 5 years and had two children living and well; the youngest was 18 months old. After the birth of the last child in March, 1918, she noted pain and aching in the right lower quadrant of the abdomen, and later noted a hard mass in this region. At the same time urinary urgency and frequency developed and a slight transient hæmaturia. These symptoms continued until July, 1919, when the patient, 5 months pregnant, had an abdominal exploration elsewhere. Exploration revealed a spindle-shaped, smooth, firm, glistening tumor not adherent, and situated in the mesentery within 20 centimeters of the ileocæcal valve. The lower 15 centimeters to 20 centimeters of the ileum were intimately associated with the tumor. No glandular involvement was noted. No attempt was made to remove the growth. Two weeks later the pregnancy was terminated by the same operator. Since that time the patient had been flowing every 1, 2, or 3 weeks. Diarrhœa recurred about every 3 weeks and lasted 2 or 3 days, followed by rather obstinate constipation. The patient's appetite was fair; she had not lost weight. The bladder symptoms had disappeared.

The physical examination revealed a poorly developed and nourished anæmic young woman, weighing 120 pounds. The hæmoglobin was 75 per cent and the leucocytes 11,600. The blood Wassermann tests and the urinalysis were negative. There was a scar of a recent mid-line incision on the lower abdomen. A firm, oblong, smooth tumor could be felt low in the mid-line and slightly to the right; it was freely movable and could be easily displaced to the right hypochondriac region. It was only slightly tender. On vaginal examination the uterus was found to be slightly enlarged and boggy. A roentgenogram of the colon showed that the tumor was extracolonic. A diagnosis of abdominal tumor was made and exploration advised.

November 27, 1919, the abdomen was opened by a low, right rectus incision. About midway between the root and the border of the mesentery of the small intestine adjacent to the ileocæcal valve, an oblong hard, glistening tumor presented. Its relations to the surrounding structures is seen in Figure 1. When an attempt was made to enucleate the growth the capsule was found to be very vascular and densely adherent. In order completely to remove the mass several branches of the mesenteric artery supplying the terminal ileum had to be ligated. It was necessary to remove about 20 centimeters of the small intestine which was closely adherent to the tumor. An end-to-end anastomosis was made. A few minutes' observation showed that the circulation was not sufficient; about 6 centimeters more of the distal gut were removed and a Murphy button anastomosis made. The large raw surface of the mesentery required extensive suturing to control the bleeding. The rent in the mesentery was closed. The gall-bladder contained some fine stones but was not disturbed since they had produced no symptoms. The appendix was removed. The uterus was slightly enlarged and soft, probably subinvoluted. There were no uterine fibroids and no other tumors could be found. The wound was closed with catgut and a single Penrose soft rubber drain was left in the lower angle.

The postoperative care consisted in keeping the patient quiet with small doses of morphine and hypodermoclysis; all fluids and nourishment by mouth were withheld. On the second day there was slight distention and the patient vomited; gastric lavage gave immediate relief. Drainage from the wound was serosanguinous. The temperature slowly rose to 104° and the pulse to 120 on the fourth day, after which it fell gradually. A successful enema was given on the sixth day. The Penrose drain was removed the eighth day and hot dressings were applied to the wound which was draining a moderate amount of seropurulent material. On the fifteenth day a fluoroscopic examination showed the Murphy button in its original position. The temperature became normal on the eighteenth day and the patient was allowed to be up. She left the hospital on the twenty-first day. The wound was healed and dry on the twenty-sixth day and a roentgenogram at that time again showed the button in its original position. The patient was discharged from the clinic on the thirty-second day.

The pathological report was: encapsulated fibromyoma, 11 centimeters by 7 centimeters by 8 centimeters, weighing 320 grams. The tumor is shown in Figure 2, and a cross section of it in Figure 3. Figures 4, 5, and 6 are photomicrographs of the tumor tissue.

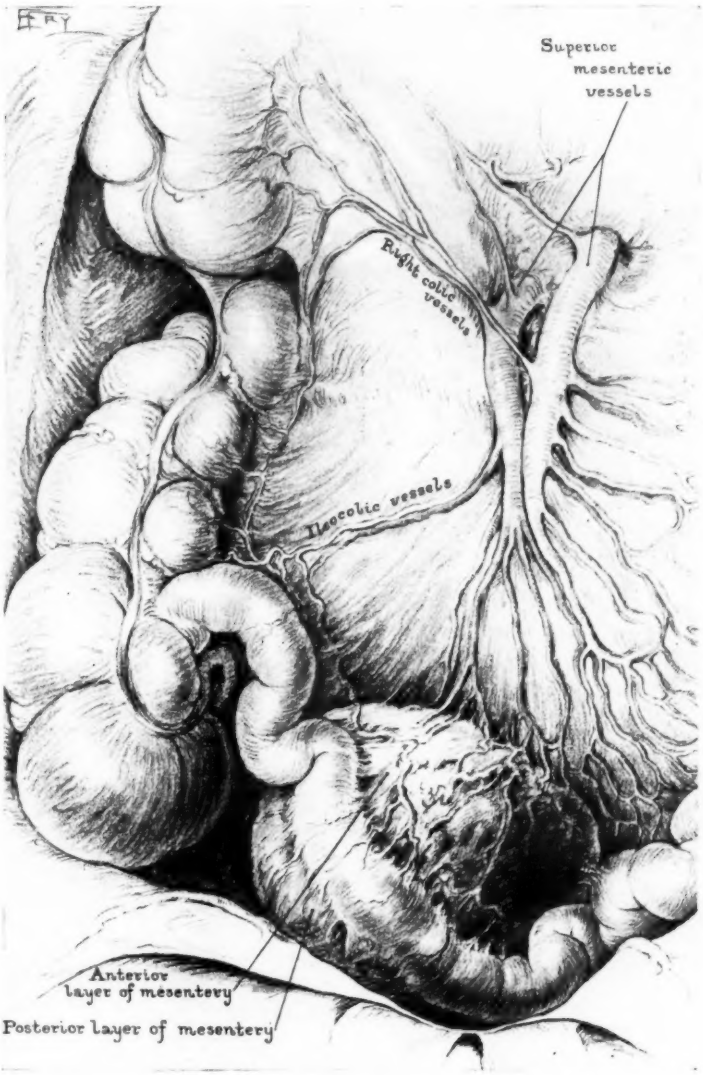

Fig. 1 (296629). Relation of fibromyoma of the mesentery to the surrounding viscera and blood-vessels.

The early history of solid tumors of the mesentery is well recorded by Harris and Herzog, who reviewed 56 cases collected from the literature up to 1897, and added one of their own. The tumors were about evenly distributed between the sexes. Sixty-six per cent occurred between the thirty-first and the sixtieth years. Sixteen were diagnosed carcinoma, 15 lipoma, 7 sarcoma, 6 fibroma; the diagnosis in the remainder was either mixed types or indefinite. Harris and Herzog believe that probably none of the diagnoses were microscopic. Bowers states that of the solid tumors of the mesen-

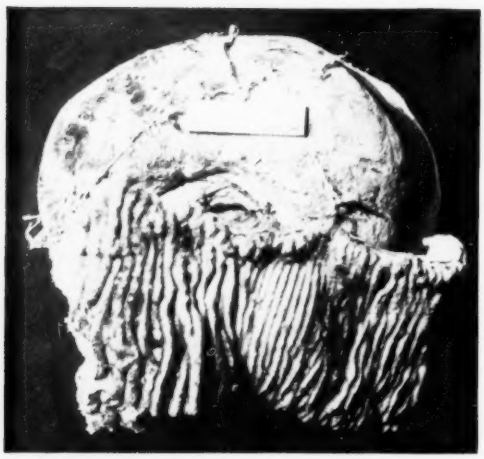

Fig. 2. Fibromyoma with resected portion of small bowel attached.

Fig. 3. Cross section of fibromyoma.

tery, lipomata are the most common, and fibromata the rarest. Greer collected 33 fibromata of the mesentery which had been reported up to 1911. He credits Horstius (1578-1636) with reporting the first mesenteric tumor found at necropsy and Bricheteau with reporting the first fibroma in 1824. Bigelow and Forman in a recent paper state that about 100 cases of solid mesenteric tumors have been reported up to the present time.

The rarest of the mesenteric tumors seem to be the fibromyomata. Doran, in 1904, reported one case, and Bowers, in 1905, collected 4 cases from the literature. Paterson has reported one case of neuromyoma which occurred in a young male. The others, including our own case, occurred in females.

The origin of solid mesenteric tumors offers many interesting hypotheses, but has been little discussed by any of the writers on the subject. Greer states that the fibromata develop in the connective tissue, grow slowly, and rarely recur after complete removal. Royster believes that all such tumors are of mesoblastic origin, solid or cystic, and that the solid tumors may be either benign or malignant. There are two possible modes of origin in our case. The more plausible theory, it seems, is that the tumor grew *in situ*. This is supported by the fact that it lay between the leaves of the mesentery, each side being covered with peritoneum, and that it was intimately associated with the essential circulation of the lower part of the ileum. The other theory is that it originated in the uterus as a fibroid, became a migratory tumor, and attached itself to the mesentery. The fact that benign migratory tumors rarely affect the essential circulation of the part to which they become attached, and that no other fibroids were found in the uterus, leads us to believe that the tumor began and grew in the situation in which it was found at operation. What effect, if any, the pregnancies had on its growth could not be ascertained.

The diagnosis of mesenteric tumors is always difficult and often impossible. Greer cites pain and constipation as the most constant symptoms, and says that the tumor may be noted from a few weeks to 15 years before the patient consults a physician. The mass is usually to the right and below the umbilicus, and not adherent. Ascites may be present in the malignant types, but Bevan in reporting a very large fibroma does not speak of finding it. Doran believes that diagnosis is impossible in most cases. The differential diagnosis is mainly between intestinal tumors, tumors of the liver or pancreas, cystic and solid ovarian tumors,

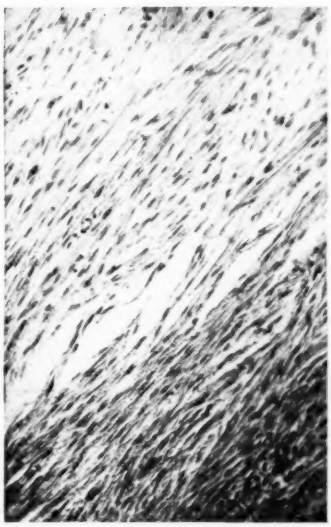

Fig. 4. Photomicrograph of section of tumor at *a*, Figure 3.

Fig. 5. Photomicrograph of section of tumor at *b*, Figure 3.

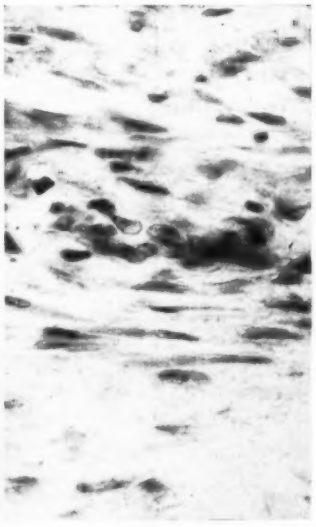

Fig. 6. Photomicrograph of section of tumor at *c*, Figure 3.

fibroids, omental tumors, and tumors of the kidney. Renal tumors may be easily ruled out by urologic methods, and tumors of the intestine by intestinal and colonic roentgenograms. Douglas advises percussion in the Trendelenburg position as a means of excluding uterine and ovarian growths.

The prognosis in fibromyomata of the mesentery is only fair. Vance reports a mortality of 40.7 per cent in 27 cases; in 13 of these, in which resection of the intestine was necessary, the mortality was 46.15 per cent. Begouin reported a mortality of 52 per cent in 29 cases. There was one death in the 7 cases of fibromyoma, a mortality of 14 per cent. Our case was the only one which required intestinal resection. Undoubtedly earlier diagnosis and operation will aid materially in lowering the mortality.

The treatment of benign mesenteric tumors is surgical. Enucleation with careful hæmostasis of the vessels in the capsule and repair of the rent in the mesentery is the method preferred. Hæmorrhage, shock, sepsis, gangrene of the gut, or failure of the anastomosis, are given as the most frequent complications. Complete recovery followed a very extensive resection by Shepherd, who excised almost 8 feet of the small intestine in removing a fibromyoma.

REFERENCES

1. Begouin. Quoted by Greer.
2. Bevan, A. D. Huge fibroma primary in the mesentery at the ileocæcal junction. Surg. Clin., Chicago, 1918, ii, 479-487.
3. Bigelow, L. L. and Forman, J. Lymphosarcoma of the mesentery. Ann. Surg., 1920, lxxi, 11-15.
4. Bowers, L. G. Tumors of the mesentery. Ann. Surg., 1906, lxiv, 892-900.
5. Doran, A. Fibromyoma of the mesentery. Brit. M. J., 1904, ii, 1075-1081.
6. Douglas, R. Quoted by Greer.
7. Greer, W. J. Fibromatous tumors of the mesentery. Brit. M. J., 1911, ii, 1085-1089.
8. Harris, M. L., and Herzog, M. Solid mesenteric tumors. Ann. Surg., 1897, xxvi, 66-82.
9. Paterson, P. A neuromyoma of the mesentery. Lancet, 1913, ii, 997.
10. Royster, H. A. Tumors of the mesentery with report of four cases. J. Am. M. Ass., 1911, lvii, 534-538.
11. Shepherd, F. J. Successful removal of an enormous mesenteric tumor and nearly 8 feet of intestine. Brit. M. J., 1897, ii, 966-968.
12. Vance, J. Solid tumors of the mesentery. Ann. Surg., 1916, lxiii, 366-379.

DIVERTICULA OF THE DUODENUM

Their Clinical and Roentgenological Recognition

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THE frequency and importance of diverticulosis of the alimentary tract has escaped attention until recent years. It is now appreciated that colonic diverticula are of common occurrence, particularly in the aged, and the surgical complications to which they give rise are generally recognized. One of us (Roberts, 1) in 1917 called attention to the great frequency with which colonic diverticula could be demonstrated in the course of systematic radiographic studies of the gastro-intestinal tract. Diverticula of the small intestine are still regarded as rarities. The literature on the subject largely concerns itself with a discussion of the accidents to the persistence of the omphalomesenteric duct, the diverticulum of Meckle. Duodenal diverticula of another nature were first described by Chomel (2), in 1710, and by Morgagni (3), in 1839. Buschi (4), in 1911, was able to collect from the literature only 54 cases which he regarded as true duodenal diverticula. Linsmayer (5), in 1914, reported finding 45 definite instances of true duodenal diverticula in a consecutive series of 1367 (4 per cent) performed by him with the direct intention of determining the incidence and etiology of the lesion. It would seem from these figures that we must revise our ideas as to the frequency of this lesion and admit that clinical experience, exploratory surgery, and the routine necropsy have given us an erroneous notion of the frequency and possibly the importance of these pouches. We are confirmed in this opinion by the frequency with which we individually have found these diverticula in routine radiographic examinations, since our attention was directed to the subject by the discovery of a few striking cases.

ANATOMICAL DESCRIPTION OF TRUE DIVERTICULA

The most common situation of these pouches is the second portion of the duodenum, close to the fold of Vater, and hence sometimes called "diverticula perivaterns." Usually they spring from the inner and posterior aspect of the gut so that they lie in close contact with the pancreas. In only about 3 per cent of cases have they been found to arise from the first portion of the duodenum, and in only a very few instances have they been found in the third and fourth portions and in the jejunum. Usually they are single, but sometimes there are as many as three or four. They vary in size from 1 to 4 centimeters in the large diameter, from the size of a pea to a small pear. The opening may be as large as the lumen of the small diverticulum, but as the size increases the ostium may remain small so that the pouch presents a narrow neck. Occasionally they have been found to contain food remnants and detritus even when the duodenum and stomach have been entirely empty. The mucosa and the submucosa are normally present, the musculature lacking except for a few scattering fibers about the opening. The glands of Lieberkuhn are present, the glands of Brunner absent. Bits of pancreatic tissue are frequently found in the mucosa of the diverticulum.

In one case included in our series, this pouch, which had been recognized radiographically just below the gall-bladder filled with tiny stones, was found at operation to be situated rather high on the posterior and outer aspect of the duodenum after a very careful search by the operator (Erdmann). (Fig. 1.) It was flaccid, covered by the peritoneum of the gut so that it made a flat pouch-like swelling, the nature of which would have been unsuspected under ordinary conditions. The pouch was readily peeled off from the gut down to the constricted opening. It will be noted in the roentgenogram that the neck of the sac pointed downward (Fig. 2).

OPINIONS ON CAUSATION

The conflicting opinions on the causation of these diverticula may be summarized as follows:

1. They are congenital in their nature representing abortive attempts at the formation of a supernumerary pancreas. This view is supported by the studies of Lewis and Thing (6), Letulle (7), Falconer (8), and Tandler (9).

2. They are congenital only in the sense that these pancreatic anlages cause local defects in the musculature and the possibility of pouching results from age, intestinal atony or an increase of intraduodenal pressure. This view is held by Linsmayer from his exhaustive study of autopsy material (loc. cit.).

3. An essential weakness at the fold of Vater according to Fleischman (10) is a potential cause of herniation at this point.

4. Traction from without from gall-bladder disease and atrophic pancreatitis has resulted in diverticula according to the observations of Keith (11) and Roth (12).

5. Pressure from partial obstruction below the diverticula was responsible for cases recorded by Keith (13) and Jachs (14). Keith has particularly emphasized the importance of enteroptosis and partial obstruction at the duodenojejunal junction as the cause of back pressure.

6. Attention has been called by Perry and Shaw (15), Moynihan (16), Linsmayer (loc. cit.) and Wilkie (17) to the association of diverticula with duodenal ulcer. These diverticula are true herniations of the inner coats and are not to be confused with the pouchings of the uninvolved portions of the cap which are pouchings of all the wall.

ANALYSIS OF 30 CASES

Our combined case series recognized radiographically now numbers 30, excluding from the series many cases of pouching of the uninvolved portion of the cap in duodenal ulcer.

Twenty-three were located in the second portion of the duodenum, 2 doubtful in either the first or second portion, 2, 1 certain in the first portion, 2 in the third portion, and 1 in the fourth. Four were associated with doubtful evidence of duodenal ulcer, 3 with evidence of gastric ulcer. In 11 cases there was evidence of pylorospasm. In 2 cases two diverticula were found and in 1 case three.

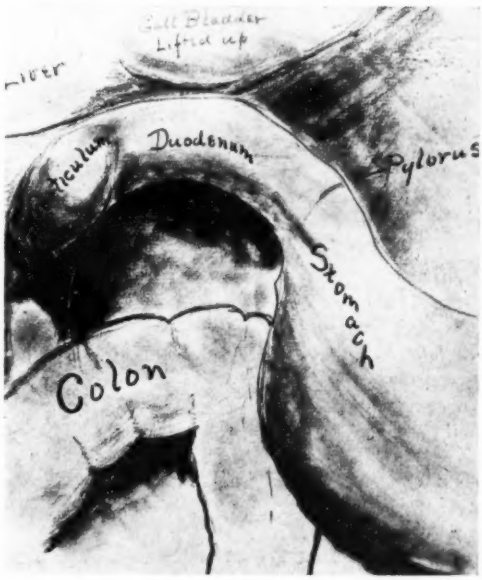

Fig. 1. Drawing of duodenal diverticulum. At operation it was less obvious than shown and would not have been discovered except for previous skiagraphic recognition (Fig. 2).

COMPLICATING PATHOLOGICAL CONDITIONS AND CLINICAL RESULTS

There are few records of serious results in any way connected with the presence of duodenal diverticula. Bauer (18) reported one case in which the diverticulum caused fatal intestinal obstruction. Forssell and Keyes (19) report a case discovered radiographically and cured of persistent digestive complaints by the removal of the sac. The case reported by Basch (20) was apparently relieved of symptoms after operation. Erdmann (personal communication) states that a case operated on by him was relieved of long persisting regurgitation of food. Wilkie (loc. cit.) reports one case in which hæmorrhagic pancreatitis was the immediate cause of death. Case (21) states that he has found

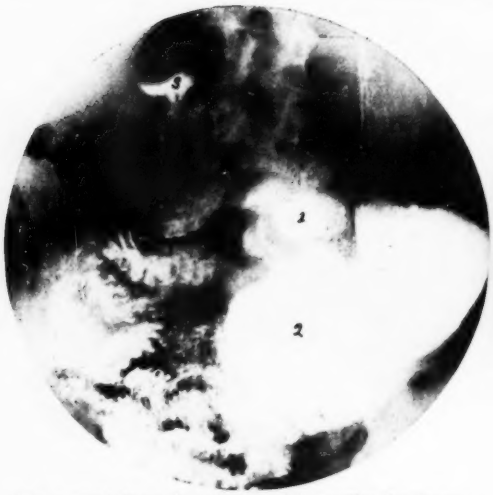

Fig. 2. Single large diverticulum of descending duodenum, schematic drawing of which is shown in Figure 1. The ostium is low and pouch empties quickly. Air bubble in pouch was constant. Plate taken in erect posture. *1*, Umbilical marker; *2*, stomach; *3*, pouch.

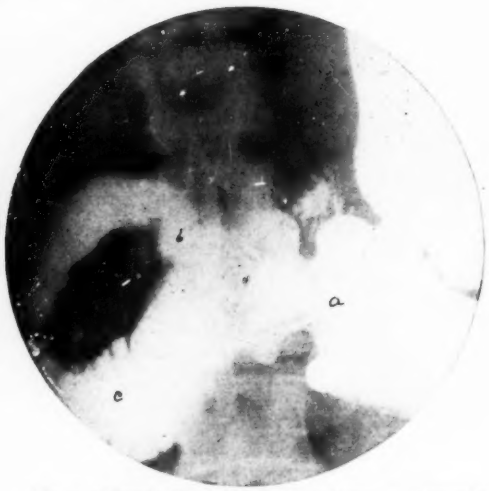

Fig. 3. Diverticulum of perivaterns type. *a*, Stomach; *b*, cap; *c*, ascending or third portion of duodenum; *d*, pouch.

diverticula in patients who give clinical evidence of chronic pancreatitis. No mention is found in the literature of cancerous development in these pouches, but it would seem from the frequency with which pancreatic tissue is found in the wall of the diverticulum this must be considered as a possible cause of that rare lesion, primary duodenal carcinoma.

ROENTGENOLOGICAL DIAGNOSIS

The roentgen finding characteristic of duodenal diverticulum is a localized accumulation of the opaque meal adjacent to the

Fig. 4. Large diverticulum situated on the outer side of the descending duodenum. *a*, Stomach; *b*, cap; *c*, diverticulum.

Fig. 5. Single diverticulum of descending duodenum. Ostium is above and pouch holds meal for many hours after emptying of stomach. *1*, Stomach; *2*, cap; *3*, pouch.

Fig. 6. Single diverticulum of second portion of duodenum with chronic ulcer of cap. *1*, Stomach; *2*, deformed cap; *3*, pouch. Taken in erect posture. Note fluid level.

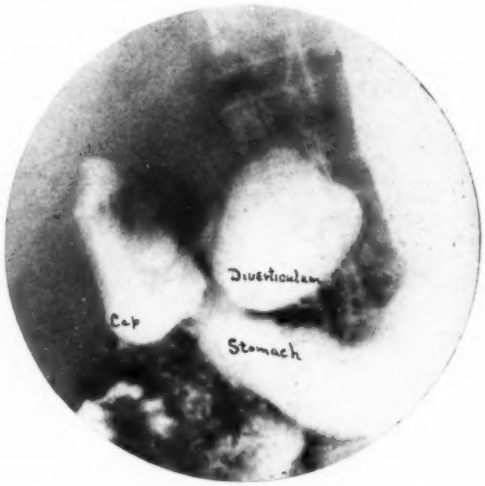

Fig. 7. Two diverticula of duodenum. Small shows air bubble. Large holds meal over night.

duodenum. This may be so small as to be scarcely visible, not larger than a grape seed (Fig. 3). It may be as large as a hen's egg (Fig. 4). It may show most distinctly immediately after the taking of the opaque meal, or at a later period, 2, 4, or 6 hours after the meal. At times it is best shown 24 hours after the evacuation of the stomach, and this fact becomes of importance in the differential diagnosis of kidney and gallstones.

True duodenal diverticula fall more or less definitely into two anatomical groups. In

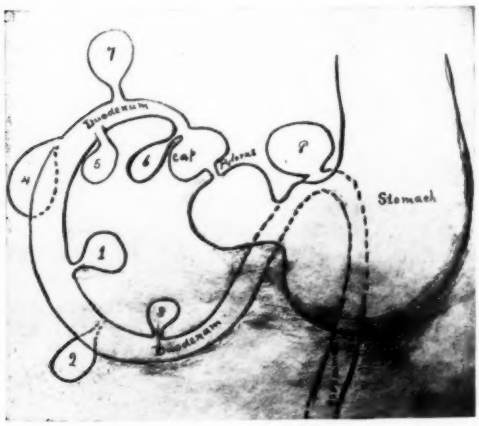

Fig. 8. Schematic drawing of sites of duodenal diverticula. *1*, Perivaterns type; *2*, *3*, and *8* are infrequent. *6*, Easily confused with dilatation associated with a cap ulcer.

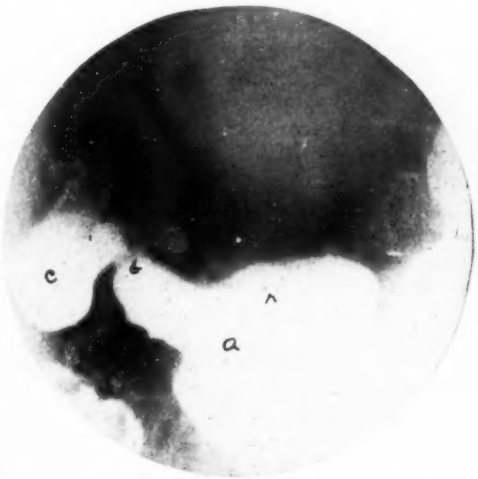

Fig. 9. Dilatation of the part of cap not affected by ulcer. Resembles a diverticulum skiagraphically but is not a true diverticulum or herniation of the mucosa through muscular layer but a pouching of entire wall. *a*, Stomach; *b*, pylorus; *c*, dilated pouch.

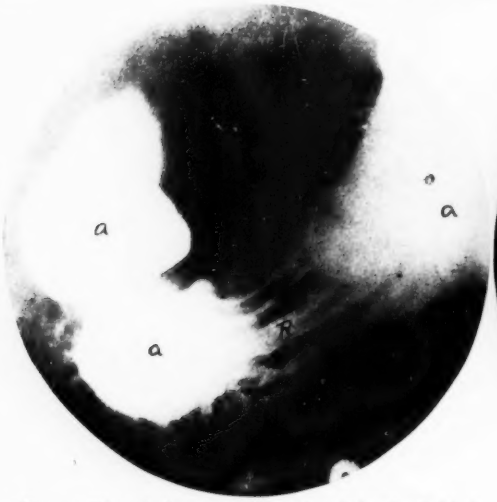

Fig. 10. Diverticulum at duodenojejunal showing behind the stomach. *a*, Stomach; *r*, rugæ of stomach, shown because of pressure; *d*, diverticulum.

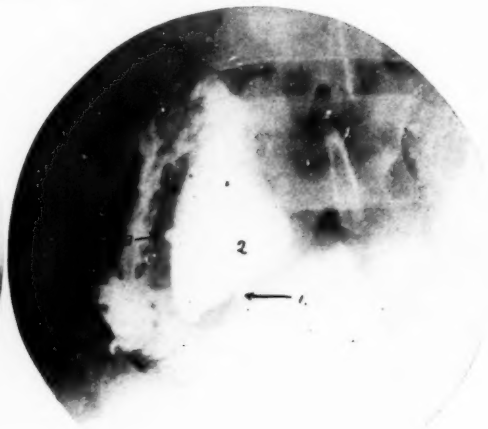

Fig. 11. Tiny diverticulum of normal cap as proved by operation. Resembles crater ulcer. Diverticulum varies in different exposures, in some having a mushroom appearance. *1*, Pylorus; *a*, cap; *3*, arrow points to pouch.

the first of these the ostium lies close to the papilla of Vater and the pouch lies definitely within the C or loop of the duodenum, in close proximity to the head of the pancreas (Fig. 3). This is such a definite group that the term *diverticula perivaterns*, adopted by the French, is most apt. A diverticulum of this group, one of us (Cole) in 1912 (22), misinterpreted and reported as a dilatation of the ampulla of Vater.

The second group comprises those diverticula, the origin of which is not adjacent to the papilla of Vater, and at such a distance from it that the diverticulum could not be mistaken for a visualized ampulla of Vater. Those pouches which originate on the upper portion of the descending duodenum lie either to the right or left side or in front or behind it (Figs. 5 and 6).

Diverticula occur infrequently in the horizontal and terminal portions of the duodenum even as far along as the duodenojejunal junction. The differentiation of diverticula at the duodenojejunal junction and perforating gastric ulcer becomes a matter of the utmost importance and will be considered later. Some of these pouches arising from the descending duodenum are in such close juxtaposition with the cap that it is difficult to exclude the cap as the point of origin. Again the pouch itself may so closely resemble the cap as to be mistaken for it. This is probably one of the explanations of the infrequency with which these pouches are recognized.

Inasmuch as these pouches have no muscular coat, their emptying is dependent on gravity and pressure from without. Obviously some pouches cannot drain while the subject is in the erect posture, but may be better drained in the prone or recumbent posture. In consequence of this it is seen that some pouches hold the opaque meal longer through the day and some longer through the night. The size of the ostium and its relation to the pouch largely determine the readiness with which it fills and empties. In the perivaterns group the pouch is usually readily drained because the ostium is at the lowermost point in the neck of the pouch and points downward. Frequently in these pouches which arise from the upper part of the descending duodenum the ostium is above the fundus of the pouch and drainage is slow, particularly while the subject is up and about (Fig. 6). When the diverticulum holds its bismuth

many hours after the emptying of the adjacent portion of the tract, it is presumptive evidence that we are dealing with one having a high lying ostium. It seems very probable that these pouches which retain the opaque meal gradually increase in size from year to year and tend to become a source of danger and more likely the cause of clinical symptoms. This group furthermore is more readily demonstrable and amenable to surgical procedure than the perivaterns group which lie in close proximity to the head of the pancreas. In our experience the diverticula of the perivaterns group seldom retain their contents after the duodenum becomes empty.

These pouches are free from the characteristic ring-like or fern-like appearance of the descending duodenum caused by the valvulæ conniventes, and they are also free from the longitudinal rugæ of the gastric mucosa which are sometimes observed in the cap. The neck of the sac, especially in the perivaterns type, has a puckered appearance (Fig. 2). These pouches may be single or multiple as in Figure 7. In some instances both anatomical groups of diverticula may occur in the same case. A diverticulum may be shown in the duodenum near the duodenojejunal junction (Fig. 10).

While it may be true in some instances that duodenal diverticula are not the cause of clinical symptoms, they are unquestionably of importance from the roentgenological standpoint, in that they may be confused and must be differentiated from a large number of lesions which are of undisputed clinical and pathological importance.

DIFFERENTIAL DIAGNOSIS

Diverticula must be differentiated skiagraphically from their pathological conditions, which fall into two groups.

Group 1 includes those in which the roentgen findings occur before the ingestion of the opaque meal, and are caused by conditions such as renal calculi, gall-stones, calcified mesenteric or retroperitoneal glands, calcified Gleason's capsule, fæcaliths, and pancreatic calculi. A diverticulum may hold sufficient food to make its visualization possible, especially if the patient has previously ingested salts of bismuth, barium, iodine, or bromin.

Group 2 includes those pathological processes in the gastro-intestinal tract which may be visualized by an opaque meal.

a. Part of the cap may be deformed by induration or cicatricial contraction from an ulcer. That part of the cap which is uninvolved with such indurations and cicatricial contraction may be dilated and compensate for the contracted area, and such dilations closely resemble certain types of diverticula (Fig. 9).

b. A small diverticulum of the cap may with difficulty be differentiated from a penetrating ulcer. The diverticulum presents more of a puckered appearance with a small ostium and changes more than does the penetrating ulcer on a series of plates (Fig. 11).

c. Perforation of a small duodenal ulcer with formation of a small accessory pocket has been observed, and the differentiation from a true diverticulum can hardly be made except from the history of the case and shrinking of the pocket in the course of several months (Fig. 4).

d. Perforation of the duodenal ulcer into the gall-bladder or the passage of a stone through the gall-bladder and duodenal wall has given rise in several instances to the filling of the gall-bladder with the opaque meal.

e. Isolated collections of barium may be found in the haustra of the colon several days or a very short time after the meal has been taken.

f. Isolated collections of opaque meal may be retained in the crater of an ulcer on the posterior wall of the stomach or more rarely near the greater curvature. The differentiation has to be made by careful study of the series at various times after the ingestion of a meal and in various postures (Fig. 10).

BIBLIOGRAPHY

1. Roberts. Surg., Gynec. & Obst., 1918, xxvii, 369.
2. Chomel. Hist. d l'Acad. roy., Par., 1710.
3. Morgagni. Trad. ital., Firenzi, 1839.
4. Buschi. Arch. f. path. Anat., etc., Berl., 1911, ccvi, 121.

5. Linsmayer. Verhandl. d. deutsch. path. Gesell., 1914, p. 445.
6. Lewis and Thing. Am. J. Anat., 1908, viii, 505.
7. Letulle. Bull. et mém. Soc. anat., Paris, 1898.
8. Falconer. Lancet, 1907, i, 1296.
9. Tandler. J. Morphol., 1902, xxiv, 187.
10. Fleischman. Leichenoeffnungen. Erlanger, 1815.
11. Keith. Lancet, 1903, i, 639; Brit. M. J., 1910.
12. Roth. Arch. f. path. Anat., etc., Berl., 1872, lvi, 197.
13. Keith. Loc. cit.
14. Jachs. Inaugural Dissertation, Kiel, 1899.
15. Perry and Shaw. Guy's Hosp. Reports, 1893.
16. Moynihan. Duodenal Ulcer. p. 216.
17. Wilkie. Edinborough M.J., 1913, xi, 219.
18. Bauer. Wien. klin. Wchnschr., 1912, xxiii, 879.
19. Forssell and Keyes. Nord. med. Arch., vol. xliii.
20. Basch. Am. J. M. Sc., 1917, cliii, 833.
21. Case. Am. J. Roentgenol., iii, s. 6.
22. Cole. Arch. Roentgen Ray, 1912, April.

FUNCTIONAL MENSTRUAL DISTURBANCES

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THESE as well as all forms of menstrual disturbance are not as common as they used to be. A physician who examined a large number of college girls 10 years ago found that 75 per cent had dysmenorrhœa quite regularly. At the present time, out of 749 college girls only 17 per cent were troubled at all by pain at the menstrual period, and only about half of these regularly.

The reason for the decrease I believe to be first an improved attitude in the minds of the girls toward the menstrual function. For the most part they now consider it as they should, a normal function, one which should not give pain, and not to be anticipated as a time of invalidism.

The second reason for the improvement is, I think, that girls are now indulging in a much greater degree of general activity than formerly and are not even omitting the activity during the period. This means improved pelvic as well as general circulation, improved muscle tone throughout the body and also in the lower abdomen, increased tone of all tissues, including the ligamentous supports of the generative organs, and the rarer occurrence of chronic constipation likely to cause pelvic congestion.

The first step in the treatment of the dysmenorrhœa which is still seen often enough to make it of considerable importance among girls not as actively inclined or as intelligent as college girls, is based on these premises. The attitude of mind of the patient must first be gotten right. She must realize that the menstrual function was not intended to be a cause of suffering any more than is the digestion of food or any other equally normal function. I have come across many a girl who stays at home during the period, often in bed, for no particular reason except that she thinks she is ill, and that it is the thing to do—thinks she is practicing a wise prophylaxis. But more often now we find girls who will not do this, although strongly urged to by their mothers, and sometimes by their physicians. Mothers of girls who have dysmenorrhœa need especially to be educated. We still find many a superstitious mother who forbids all kinds of baths during the period, and who puts her foot down on the usual activity, such as dancing or hiking. First of all we must get both mother and daughter to stop calling the menstrual period a "sickness." Countless thousands of women can prove that it is not naturally thus, and can be made not thus by more normal habits of living and thinking. I have never seen a single girl harmed by any activity which she would normally take or any kind of baths to which she was habituated, even cold ones, when taken straight through the period. The activity and bathing tend not only to eliminate pain, but tend also to shorten the duration of the flow, an advantage if no ill results follow, as has been demonstrated to be the case. I am not advocating a mind cure for dysmenorrhœa but simply an adjustment of the mind to the condition as it is, rather than as it has been considered so long, on no other grounds than superstition. In my experience this

change of mental attitude and this alone, without any treatment of any kind, will effect a cure in a large proportion of cases, because the girl who is not thinking of herself as "ill" will conduct herself in a normal way, living as she does the rest of the month, taking her exercise as usual, and not making it difficult by coddling herself for any of her functions, including the menstrual one, to procede normally. In a certain large girls' college, the girls are required to report at any and all class work in the morning as usual, pains or no pains. They may then be excused if it is absolutely necessary, but strange to say, or rather from one point of view quite naturally, once the girls are out and about, their troubles seem to be less severe, and they usually do not ask to be excused.

Out of a very large number of girls troubled with menstrual pain (more than 2,000), pelvic examinations were made in only 5 per cent, for we had the usual reluctance to do this unless it seemed quite necessary. Ninety-five per cent were considered suitable to treat according to the foregoing plan, and others to be discussed, for a time at least, before examination was made. The symptoms complained of were about equally "cramps" and backache with bearing-down pains. In not one of the cases so treated was examination subsequently necessary, as the improvement under general and special hygiene was sufficiently marked to confirm the diagnosis of functional rather than organic trouble. In the 5 per cent examined, 3 per cent showed nothing discernible by the methods of one who is not a specialist in gynecology, except relaxed ligaments, tilted and bent positions of the uterus, which it was thought suitable for the same hygienic treatment as was given to those unexamined. One or two out of the series did not respond to treatment and were subsequently operated on. One or two were unable to carry out any hygienic measures directed to this end, on account of the immediate necessity of treating other conditions, and were lost sight of by us. No cases in which there was specific infection were included. The remaining 2 per cent examined showed such definite necessity for medical or surgical gynecological treatment that they were referred elsewhere at once.

The treatment instituted for 98 per cent of the girls, then, was that of general and special hygiene. General hygiene, including the mental attitude spoken of above, consisted of the increasing of bodily vigor in every way in which it was found necessary in the individual cases. Increase of weight in some cases improved the position of the pelvic organs and relieved the symptoms. General improved circulation was responsible for many cures. In some of these cases the result was attained so promptly that if reported exactly as it occurred it would sound like the advertisement of a patent medicine. Discontinuing invalid habits was the chief factor in the improvement.

Out of the 98 per cent it was found that except for the activity necessary for work, most of the girls omitted all activity during the period, and these were invariably the ones who suffered most. They had a different idea from that held by us, however, as to which was cause and which result. Dancing was indulged in with fear and trembling by some, watching for the dire results. We too watched for dire results when we recommended the girls to go to gymnasium, go on hikes and play tennis and skate at such times, because we were not sure that they could at once be educated to the point of nonchalantly behaving as usual. But no ill effects followed in any case from planning any variety of bodily activity, quite ignoring the menstrual function.

Half of the 98 per cent were troubled with constipation, which in these cases undoubtedly played an almost exclusive rôle as cause of the congestion resulting in dysmenorrhœa. Many of these girls realized that this condition had some bearing on their menstrual pain, partly because of having been so instructed by doctors or nurses. A number were in the habit of taking cathartics before or during the period. We advised them of the desirability of getting rid of the constipation entirely, not only for the length of the period, by means other than cathartics,—means that would at the same time tend toward the improvement of the

dysmenorrhœa directly, rather than indirectly through temporary relief of the constipation by cathartics. The methods advised are regularity of habit, both in regard to ingestion and elimination, drinking of plenty of water, eating those foods with a chemically laxative effect and those with a mechanically laxative effect through increasing peristalsis, taking sufficient quantity of all kinds of food to give the intestinal contents bulk, but not overeating, chewing the food well to promote digestion all along the line, kneading the abdomen, getting sufficient general exercise, and finally taking special exercises directed toward the lower abdomen.

The other 49 per cent had dysmenorrhœa but no chronic constipation. In most of these the trouble was due to weak abdominal muscles and consequent sagging of the abdomen causing poor position of the abdominal and pelvic viscera; and poor circulation through these organs. The symptoms in many of these cases were of flexion or version of the uterus and narrowing of the lumen of the cervix. A general weak musculature was noted in many of these cases throughout the body. But a number of the girls were of a well developed athletic type, nevertheless showing a similar poor development of the recti and oblique muscles. This goes to show that general development can, unless special attention is directed to them, entirely miss developing certain most important muscles. That any of these girls were free from constipation was surprising.

Other disturbances of menstrual function were common in the series. Metrorrhagia and menorrhagia, although undoubtedly often due to conditions not relievable by the treatment under discussion, have been sufficiently often so relieved that a trial of them in most cases is indicated. Whether the improvement be due to the general exercise, acting on the general health and possibly on the internal secretions, or to the special exercises acting locally, we have not determined. Leucorrhœa, when the symptoms and history are such that no infection is suspected, has been treated in the same way, with excellent results. This helps solve the problem in the case of well young women entirely above suspicion, in whom there is no demonstrable cause of leucorrhœa, yet who are often seriously annoyed by it. In some of these cases, however, a considerable change in the habits of living was necessary before results were obtained. The most severe trouble of all kinds was invariably found in those who sat still a great deal of the time, and took little but emotional recreation. Office clerks, who spend their spare time reading and sewing and going to the theater formed the bulk of the series.

The treatment of 98 per cent of cases consisted, then, of what has already been discussed, and of special exercises to improve both muscle control and circulation in the area involved.

In asking many hundreds of girls whether they knew they had any muscles in the abdominal wall I have been surprised to find that most of them were quite unaware of the fact that anything but epidermis and fat covered the abdomen. Most of them attributed their prominent abdomens to an undue size of the abdominal organs, many of them considering it an hereditary defect, as their mothers were built the same way! When they were asked to contract the muscles and draw in the abdomen they were unable to utilize a particle of voluntary control. In some of these girls it has taken weeks to teach them to budge them half an inch. What wonder that not only the reproductive organs but also the digestive ones frequently suffer. There was distinct visceroptosis in some of the cases, and the reflex nausea and vomiting which often accompany "cramps" were all the more easily produced on this account.

We have first endeavored to give the girl the idea of using the abdominal muscles. Once she gets it she can, first by an effort and later naturally and subconsciously, support the organs far better than any artificial device, either in the form of corsets, supports, bands or pessaries, which ought to be reserved for those cases in which the ability to cultivate muscle power is demonstrably impossible or impracticable (just as are arch supports).

Voluntary muscle control is taught in the original examination and in the gymnas-

ium before a triple mirror. In the examination the patient is to be undressed. Seeing herself first as she naturally stands, and then as she should stand, will make a more vivid impression on her mind and also on her muscles than any words on the subject. The physician and physical director should assist her in her first efforts to do two things: (1) to adopt the proper posture, and (2) to hold it by making tense the abdominal muscles.

Self correction of posture may not be possible on account of rigidity of the back, or inability to utilize muscles. She can be put as nearly in the correct posture as possible, and given exercises to make the posture easier to get. But even then she may not get it if she has not the idea and the "feel" of correct posture. For this reason I like to utilize such childish devices, even with adults, as suggesting that they imagine a hook in the top of the head near the back of it, from which they are being suspended; or suggesting that they "stand tall," which effort tends to do away with the curves of the back and neck. Another trick is to get them to make themselves anteroposteriorly as narrow as possible, so that they could pass through a door opened as little as possible. Standing against a wall and feeling the wide space between the wall and the small of the back, and observing how difficult it is for them to put head, heels and waist against the wall at the same time will show them how far from erect they are. Often girls who are able to stand this way do not do it because they feel that they will appear to be "strutting." This idea may be counteracted by showing them that someone whose figure and carriage they admire, usually one of the physical directors, is in this erect position normally. Personally I prefer the suggestion of hanging from a hook in the top of the head. The attitude they strike in response to this suggestion is usually as near normal correct posture as is possible for them to get, and it has the advantage of not being rigid, as is posture which is built up from the feet.

To further improve and make habitual such good posture they must usually be sent to the gymnasium for exercises, but most important of all they must carry away with them the idea of good posture and adopt it during the day whenever they think of it. This applies, too, to sitting and walking posture.

The correction of the lax abdominal muscles is often harder to get than that of lordosis. At first they may be only able to draw in the abdomen by inflating the lungs, thus raising the point of attachment of the abdominal muscles, and making the abdomen look flatter. This may be permitted until they have gotten the feeling of having the abdominal organs higher than they were, and until they have seen the effect produced in the appearance of the abdomen in proper position. But this position they should not be permitted to sustain while the breath is held. Just as soon as it can be done, only normal breathing should be permitted, whatever is accomplished being done entirely by the muscles of the abdominal wall. To prove that a girl is doing this she should be asked to hold the muscles contracted and to breath in and out naturally while doing it. Ultimately breathing will be conducted normally unconsciously.

In order to develop muscle control more rapidly, it should be practiced at home morning and night, preferably before a mirror. But even this will not suffice. It must be done during the day while sitting, standing or lying down. Such clothing should be worn as will permit of correct posture and the use of these muscles constantly. The chief objection to the use of corsets is that they relieve the abdominal muscles of their normal work and at the same time do not take their place in supporting the viscera. The way the average girl wears a corset tends to push the viscera down further in fact, even the modern relatively harmless corset when worn loose, as it often is (but not often enough). Even if they do not push downward to any great extent, they do remove the unsightly appearance of a bulging abdomen, which would in itself, if not disguised, be an incentive to abdominal muscle control. I have found that a great many girls who never had dysmenorrhœa at first began to experience it after the adoption of corsets, not at once of course but gradually.

And a number had ceased having pain upon leaving them off apart from special training of the muscles.

There would be little to be said, however, against the type of corset now usually worn, if girls were educated at the same time in the use of the abdominal muscles. We have seen no bad effects produced by the wearing of corsets for the purpose of keeping the clothing in place more neatly, when the wearer quite understands that they must not be permitted to lessen the power of her own muscles. That they always do so to some extent is likely, but they need not do so to a harmful extent, if the possible crippling effect is guarded against. One can maintain good posture inside of a loose, well shaped corset as well as inside of many other kinds of clothing. Not only the abdominal but the lumbar muscles should be prevented from becoming useless in any clothing. I have recently examined several actresses, not one of whom wore corsets, nor had a bulging abdomen, nor was subject to dysmenorrhœa.

While wearing clothing of any unrestricting kind, girls can be taught to stand and sit and walk with the abdominal muscles if not actually contracted, at least in normal tone, not sagging. We advise girls to practice this contraction every time they think of it during the day, together with the practice of good posture. There is some, but little, danger of their overdoing it at first.

Doctors here and there have advocated single exercises for dysmenorrhœa alone, and have reported success in their use. But I am convinced that we should not pin our faith to any one exercise, nor hope for relief of only one disorder. Abdominal strengthening, however and wherever developed, is an absolute necessity for bipeds if they would avoid many kinds of trouble within the abdomen. We have not yet been long enough upright to have learned the use of abdominal muscles automatically. While it is menstrual disturbances in women of which I am especially speaking, it has not been dysmenorrhœa exclusively which has been helped, nor has it been pelvic disorders as a whole, exclusively. A number of other abdominal conditions in both women and men have yielded to the same treatment. This is one of the methods of "normalizing the life" which should be utilized in a very great many ailments. If there is any possibility that the condition can be helped by better position of and circulation through the abdominal or pelvic organs, I try out that possibility by having the patient taught correct posture and abdominal muscle control, of course watching for those cases which would be harmed by "stirring up."

Although self correction is the most important element it is also essential in most cases to give further exercises to strengthen the muscles that maintain posture and the abdominal muscles, and to improve the local circulation, and to do away with constipation.

The special exercises for posture should take into consideration whether the type of back is simply lordosis, or a combination of lordosis and kyphosis, or only kyphosis (long round back). The former is more common in otherwise well developed girls; the second in the average girl; the third, relatively uncommon. The presence or absence of scoliosis must also be taken into consideration.

The exercises that take care of the abdominal muscles are the same that help local circulation. They consist of the various forms of trunk bending, trunk twisting on a vertical axis, trunk circumduction, trunk raising from the lying to sitting position with heels on the floor. Other valuable exercises are body curling, a slow attempt at a backward somersault, so that after flexing thighs on abdomen and legs on thighs, the legs are extended, the lower part of the back raised from the floor and the toes reach above and beyond the head; body swinging, kneel on floor, flex knees and hips so that body is doubled up like a jack-knife, hands on floor as far forward as they will go, then swinging body on hands as far forward as possible until knees and hips are straight, lowering body to floor, then slowly returning. Prone exercises and those in Trendelenburg position should also be used. The knee chest position varies the circulation, and contraction of

the abdomen while in this position or while lying prone or on either side gives added strength to the abdominal muscles. Various combinations of bending and twisting and stretching the trunk may be used, with the arms in various positions, with or without the use of apparatus such as dumb bells, with or without support of some part of the body.

The main thing to be emphasized with each girl is that she must move her trunk so as to improve the circulation there, and that she must feel the abdominal muscles tighten as she uses them. It is foolish not to take advantage of the girl's own interest in doing the exercises for a particular purpose, although in the class of at least one physical director I have found no girl who knew why she was doing any of the exercises. She knew that she was expected to get over her troubles, but her own co-operation in directly helping herself had not been secured. Unless they have been sufficiently enlightened, it is surprising how they can manage to spare the abdominal muscles, even in exercises particularly planned to exercise them. The only improvement such girls are likely to show is an improvement in general health. It is necessary that not only pupil but teacher have the right point of view.

With the above types of exercise and the general exercise which will be taken at the same time and the sports in which girls will be encouraged to indulge, it will be surprising if constipation is not remedied, provided all the other advice in regard to digestion has been acted upon. Nevertheless it is desirable to add some particular exercises for this purpose. The most useful are various sorts of bendings of the flexed thigh and knee onto the abdomen, with or without the use of the right arm across the abdomen to increase the pressure. They can be done sitting on a chair with the feet on another chair nearly as high, or they can be done standing or lying. A modification of this exercise which amounts to doing it in the prone position, is done as follows: Kneel on floor, bend forward bringing chest on knees which are slightly bent, arms on floor folded under forehead, stretch right leg backward as far as possible, at the same time letting the abdomen sink onto the doubled up left knee, using considerable pressure, repeat with left.

These exercises have been in quite general use, most of them, for some time, but I think it is not fully realized by physicians what very definite uses they have therapeutically, since they are so seldom prescribed. Nor do physical directors very generally realize their value, for they have as a rule had no particular condition in mind to cure, using them as others in series for general exercise. Moreover even if they themselves know what they are for they seldom tell the girl, and as a result lose the valuable aid to be gotten that way, through the *education* of the girl rather than her instruction.

The exercises should all be begun gradually, as there is likely to be a little feeling of strain after them in the very inexperienced, and some discouragement may result. Most girls enter into the attempt with great enthusiasm and would willingly overdo if permitted to.

The measures outlined above for functional menstrual disturbances have the advantage over other forms of treatment that they tend toward general health and hence will be likely in any event to improve to some extent a functional disorder. In many young women whom physicians would be loath to subject to a local examination except when urgently called for, it seems permissible to attempt to promote health without the examination, by means of these physiological measures. When there is no reason for not making an examination, it would of course not be desirable to start treatment by exercises unless the diagnosis of a functional disorder were beyond question.

CONCLUSION

Mental hygiene and general hygiene, including general and special exercise, seem to be the treatment of choice in most cases of menstrual disturbances in young girls, and in many cases in older women. A large proportion of such disturbances are due to faulty muscular development and faulty circulation within the power of the individual to correct.

CALCIFIED TUBAL MOLE

By J. PRESTON MAXWELL, M.D., F.R.C.S., Peking, China
From the Gynecological Laboratory, Johns Hopkins Hospital

CALCIFICATION in extra-uterine gestation is by no means unknown and many cases have been described. One of the best discussions of the subject can be found in a paper by Kuechenmeister.[1] But in this author's paper, and in those of all others which the writer has been able to find, the condition described is one occurring in advanced pregnancy, and neither by inquiry nor by search in the museums in London or Edinburgh has any specimen similar to the one herein described been discovered.

Dr. Cullen, from whose laboratory the specimen comes, has never seen another case of the kind, so one is justified in regarding it as a rare occurrence.

J. M., a colored woman, age 55, entered Johns Hopkins Hospital on January 21, 1919, complaining of vaginal hæmorrhage. Menstruation had begun at 18, had been regular, and of 30-day type. The climacteric had taken place 4 years ago, and the bleeding of which she complained had begun in July, 1918. She had been married 38 years, had had 6 children, the eldest 34 and the youngest 29. There had been two miscarriages during or closely connected with this period, and she had been sterile for the last 25 years. There had been no history at any time of any symptom pointing to an extra-uterine gestation.

The bleeding proved to be due to a carcinoma of the cervix, and as it was doubtful whether the case was operable, an abdominal exploration was carried out by Dr. Hampton, the resident gynecologist.

On opening the abdomen, the left tube was found to end in a calcified mass which measured 3 centimeters by 2½ centimeters by 3 centimeters, and to which the omentum was densely adherent. It was irregular and nodular. The mass, with the left ovary and tube, was removed. Free access was thus given to the pelvis, and it was found that the carcinoma had invaded the rectum, and was inoperable. The right tube and ovary were normal but atrophic, and there was no sign of a corpus luteum in either ovary.

The abdomen was closed and the patient rapidly recovered from the exploratory operation.

The specimen thus obtained consisted of the left tube which ended in the swelling before mentioned. The ovary was atrophic. (See Fig. 3.)

On section with a saw, the hard nodular swelling was found to consist of a calcified shell, 4 to 5 millimeters broad. The interior contained a semi-translucent jelly-like substance, and there was a fine brightish yellow layer just inside the capsule. (See Fig. 4.) Microscopically, the tube and ovary were atrophic, and there were no signs of recent corpus luteum.

The section of the swelling itself showed degenerate chorionic villi, and in one place the remains of a decidual reaction. (See Figs. 1 and 2.)

The specimen is probably one of an ampullary pregnancy which was transformed into a tubal mole. The omentum became adherent, preventing the occurrence of a tubal abortion, and the whole mass became subsequently calcified. As to the date of the tubal pregnancy there is no evidence which would enable one to determine that. The patient was intelligent, but no amount of careful questioning could elicit any light on this point.

The writer is indebted to Dr. Cullen for permission to publish this case.

[1] Kuechenmeister. Arch. f. Gynaek., 1881, xvii, 153.

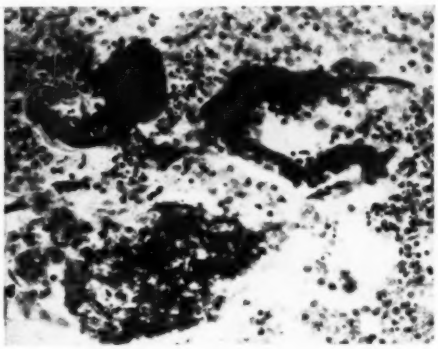


Fig. 1. (at left). Photomicrograph showing the remains of degenerate chorionic villi.
Fig. 2. Photomicrograph showing the remains of degenerate chorionic villi and decidual reaction

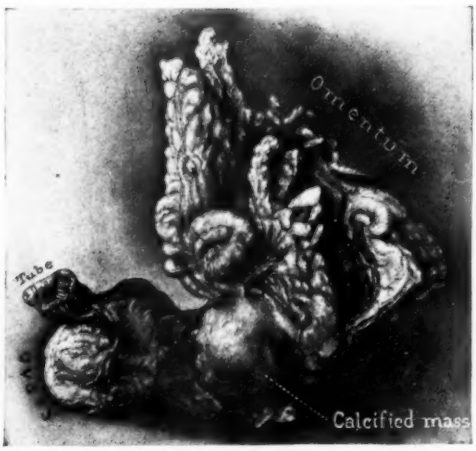


Fig. 3. Specimen removed, showing calcified mass, tube, ovary and omentum.

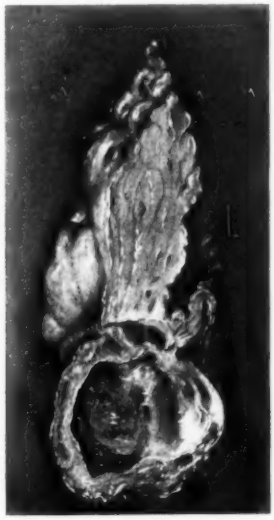


Fig. 4. Section of mass showing calcified shell, the interior of which contained a semitranslucent jelly-like substance.

CRUVEILHIER'S "TUMEURS PERLÉES"[1]

By PERCIVAL BAILEY, M.D., Boston
Assistant Resident Surgeon, Peter Bent Brigham Hospital

SINCE Cruveilhier first described, in 1829, three peculiar tumors of the intracranial cavity, one having been previously reported by La Prestre and another by Duméril in 1807, which because of their external appearance he named *tumeurs perlées*, sporadic cases have from time to time been reported in the literature. In 1838, Johannes Mueller reporting three similar cases gave them the name of cholesteatomata, because he found cholesterin crystals in their interior. But Virchow, in 1855, describing 4 cases, returned to the term "*Perlgeschwuelste*" after Cruveilhier because, as he pointed out, cholesterin was not constantly present.

The term cholesteatomata is also unfortunate because various tumors in sundry localities and of divers origins may contain cholesterin crystals and still have nothing in common with the *tumeurs perlées* of Cruveilhier, even to a collection of débris in the navel as reported by Coenen. They must not be confused particularly with those collections in the middle ear cavity following chronic otitis media which sometimes extend into the cranial cavity. In searching for references to true pearly tumors much time was wasted in following up these so-called cholesteatomata, originating in the middle ear. Cases of cholesteatomata reported to have been removed at operation will almost always be found to belong to this category. It must not be forgotten also that many dermoids, and particularly cysts in the region of the pituitary fossa, contain cholesterin crystals and these are often reported erroneously as cholesteatomata. A good example is the recent case recorded by Stenvers.

The tumors with which we are concerned are of the same nature as those described by Bostroem, in his thorough discussion under the term *haarlosen pialen Epidermoide*. But this latter designation rests on a theory of their origin, Nehrkorn and Frank simultaneously insisting as vigorously that they were endothelial in origin. It has seemed wise, in view of all this confusion, to return to the original designation "pearly tumors."

Fig. 1. Drawing of Duméril's case (*from Cruveilhier*). Cerebellum split longitudinally down to fourth ventricle which is filled by tumor. Pons seen projecting above tumor, medulla oblongata below.

Fig. 2. Case of Spillman and Schmitt. Tumor *in situ* filling the fourth ventricle and pushing the cerebellar hemispheres aside.

[1] From the clinic of Harvey Cushing, Peter Bent Brigham Hospital, Boston, Massachusetts. Read before the Chicago Neurological Society, February 19, 1920.

Fig. 3. Frick's case. Transverse section of cerebellum and medulla oblongata showing position of tumor in fourth ventricle.

Fig. 4. Photograph of K. S. Surg. No. 10302, taken on tenth postoperative day showing "cross-bow" incision.

TRUE PEARLY TUMORS

a. Incidence. Though rarely seen in man, true pearly tumors are well known to veterinarians, because of their frequent occurrence in the lateral ventricle of the horse, and they have been made the subject of a special study by Védrine.

In man, Tooth found but one in a series of 258 cases of brain tumor verified at autopsy or operation. Two tumors are listed as cholesteatomata, but it seems to me one of them, judging from the histological description, was certainly not a pearly tumor. This makes the incidence practically 0.4 per cent. Frank quotes Bernhardt as finding only one in a series of 487 autopsies on brain tumor cases, or about 0.2 per cent. Schulgin reports that 0.4 per cent of brain tumors in his series were cholesteatomata, and Meyer says that of the 11 cases Schulgin describes, but 6 are true pearly tumors. In this clinic, only 2 cases have been observed in a series of over 550 brain tumors verified at operation or autopsy. These, in traditional fashion, have come very closely together within the last 6 months. The incidence therefore in this series is 0.37 per cent, but if another long interval intervenes the incidence may reach as low as 0.2 per cent. At any rate, one may estimate that 2 or 3 in a thousand brain tumors will be true pearly tumors.

Seydel and Beck, in 14,005 autopsies, found 135 brain tumors, and when it is considered from this that fewer than 0.1 per cent of deaths in a hospital are due to brain tumors, the rarity of true pearly tumors may be appreciated.

Bostroem, in 1897, collected reports of 32 cases, and, in 1911, Frick collected 9 more, to which Meyer, in 1913, added 6 from the Russian literature and one of his own. Since 1913, counting every possibility, some being more than doubtful, I have found reports of 12 additional cases, which with the 2 reported here make 62 in all.

b. Location. The favorite location for these tumors is beneath the pons and mid-brain extending up into the cerebellopontine angle, but they may occur anywhere on the base of the brain from the anterior perforated space to the foramen magnum. Occasionally one is found in the lateral ventricle which is interesting in view of the frequent occurrence in the lateral ventricle of the horse. Rarely one is found in the fourth ventricle, but 7 cases having been reported, and in one of these the major portion of the tumor lay in the lateral recess. Chiari described a case in which the tumor was found in the spinal canal.

It should not be forgotten that these are meningeal growths and not brain tumors proper. Even cases arising from the plexus of the lateral ventricle originate undoubtedly in the pial tissue of the interior of the plexus tufts. They lie always beneath the arachnoid in the pia, a point which Bostroem stresses in his term *haarlosen pialen Epidermoide.*

c. Gross appearance. Grossly, the tumors resemble startlingly mother-of-pearl both in tint and luster. The surface is smooth, silky, with irregular pea-sized or larger elevations

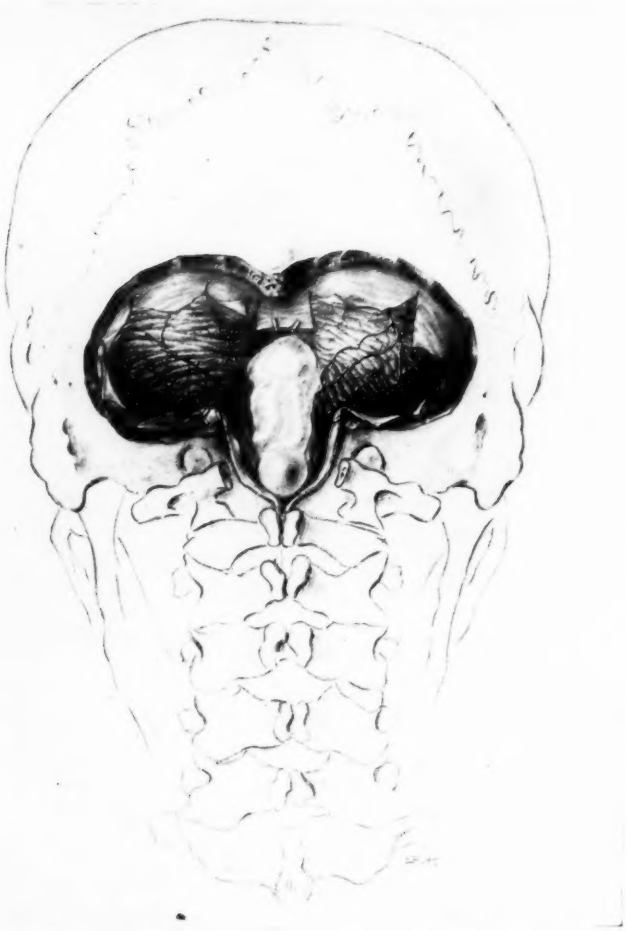


Fig. 5. Drawing showing tumor *in situ* after posterior arachnoid cistern had been opened and cerebellar hemispheres pushed somewhat aside. Drawn from a sketch made by Dr. Cushing at time of operation. K. S. Surg. No. 10302.

and peels away easily from the surroundings. The surface layers are tough, with about the malleability of heavy tin foil. From the surface, with a knife blade, flakes may easily be separated which show beautifully the characteristic luster.

The growths are usually solid but may have an irregular cavity in the center. The interior is composed of a white, dry, crumbly mass, which is very easily crushed. There is always an entire absence of blood-vessels. One of these tumors looking like a great pearl in its setting of reddish brain tissue makes a most beautiful picture.

d. Histological structure. Their histological structure is very pithily summarized by Meyer thus: "Histologically the cholesteatomata are composed of a fine fibrous wall formed of the pia whose inner surface is covered by layers of flat, polygonal cells containing keratohyalin granules, further of masses of cells which have fallen off the walls, and a fatty mass mixed

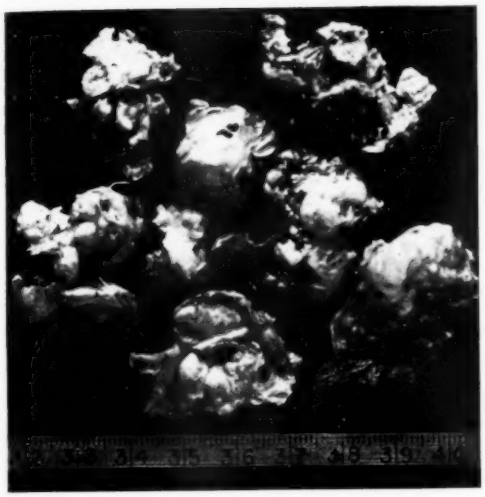


Fig. 6. Photograph of fragments of wall of tumor from K. S. Surg. No. 10302.

with cholesterin crystals. That is the microscopic structure of a pure cholesteatoma."

The flat outer cells consist of a homogeneous material giving a typical horn reaction with Gram's stain and have no nuclei. It has been claimed that the intercellular material may be successfully impregnated with silver.

Underneath these flat horny cells are polygonal cells with fairly well preserved nuclei and in whose cystoplasm numerous keratohyalin granules may be found. It is said also that eleidin granules are occasionally found, but not invariably which is not surprising since even in the skin one expects to find them only in the palm and sole. Beneke claims to have demonstrated epithelial fibers. At times definite papillæ formation may be seen. The growths never contain hair.

e. Theories of origin. There have been many theories advanced to explain their origin. Cruveilhier considered the cholesterin to be a secretory product laid down in the subarachnoid space.

Thurnam seems to have been the first to call attention to the resemblance to dead epithelial cells. In 1854, Van Remak advanced the view that they arose from embryonic epithelial cell rests.

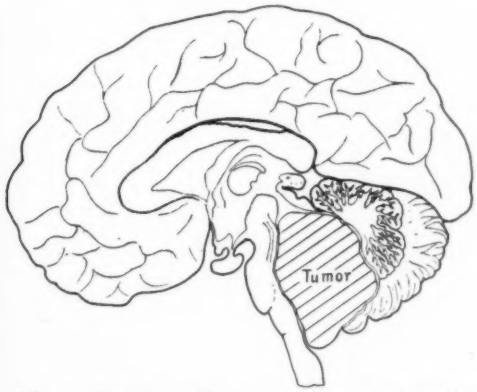


Fig. 7. K. S. Surg. No. 10302. Theoretical median section of brain showing location and relative size of tumor.

Spillman and Schmitt considered their case to have developed from the ependyma of the choroid plexus of the fourth ventricle. Benda also holds this view of their origin. Undoubtedly they may arise from the plexus, as in the lateral ventricle of the horse, but it does not follow that they develop from the ependyma. It must be remembered that the interior of the plexus is pial tissue and in this they may arise as in the pia elsewhere.

The wildest hypothesis was probably that of Auvray who considered them to be angiosarcomata which had undergone fatty degeneration.

The main controversy, therefore, has been whether they are of endothelial or epithelial origin. Beneke held that they must be endothelial because he secured a beautiful silver reaction from the cell borders.

Nehrkorn and H. Frank have insisted on an origin from the pia, and there is much to be said on their side of the argument. The tumors always lie in the pia; never contain hair, although dermoids containing cholesterin crystals may be found; and so far as papillæ formation is concerned, it may be found also in endotheliomata.

But the inconsistency of certain findings is no argument against the epithelial origin, such as, for example, inability to find eleidin granules noted above, inability to find epithelial fibers which Beneke thinks is due to alcohol fixation, etc., and the structure is so

Fig. 8. Photographs of K. S., Surg. No. 10302, taken one month after operation showing on the right hand the method of concealing operative field.

definitely epithelial that in lieu of definite proof of an endothelial origin, the epithelial origin of these growths may be considered established. Bostroem may be noted as the ablest exponent of this view.

Pearly tumors of fourth ventricle. The pearly tumors are slow-growing benign lesions which have hitherto been of more interest to the pathologist than to the surgeon, as Borchardt justly remarks. In fact, they have often been found accidentally at autopsy, their presence not having been suspected during life. Even if suspected, their locations in most cases have precluded operative interference or removal if operated, and the symptoms would in most cases not lead one to diagnose a tumor in a surgically accessible locality.

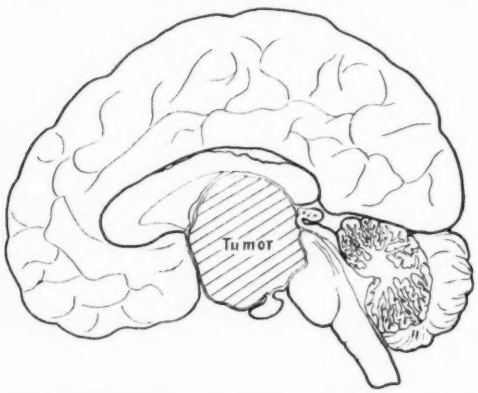


Fig. 9. R. R. Surg. No. 11152. Theoretical median section of brain showing location and relative size of tumor. Drawn from specimen with suprasellar cyst in same location. (Cushing and Walker. *Arch. of Ophth.*, xlv., No. 5, text plate XII.)

Those having their location in the fourth ventricle are most amenable to surgical interference, since they may be easily reached through a bilateral suboccipital exposure, but unfortunately they are rarely found in this situation.

CASE 1. Reported by Cruveilhier; this case was first recorded by Duméril in 1807.

History. The man was supposed to have died from a blow on the head and was never suspected to have in his brain the cause of compression. The symptomatology is lacking.

Pathology. The tumor was situated in the fourth ventricle; the cerebellar hemispheres were much compressed. The surface of the growth had a silvery white glint with knuckle-like elevations. Inside it was a greyish-white color.

Figure 1 is a photograph of a drawing from a wax model of the tumor. It would be interesting to know more of the history of the case, but of the nature of the tumor there is no doubt.

CASE 2. Reported by Thurnam. In 1854, this specimen was described by Thurnam with remarks on the frequency of insanity accompanying these tumors.

History. The patient was a 60-year old woman who for a long time showed traces of mental derangement. She had an inconstant, dull pain in the head.

Examination. Extraordinary, slow, clumsy gait, speech indistinct and hesitating, occasional convulsions.

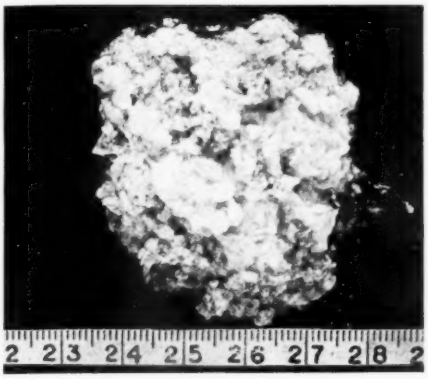


Fig. 10. Photograph of tumor mass. R. R. Surg. No. 11152. One large fragment of surface shows characteristic lustre.

Pathology. There is a walnut-sized tumor between the under surface of the cerebellum and the upper surface of the medulla oblongata, which pressed in to the convolutions and under the angle of the right cerebellar hemisphere, pushed the vermis aside, and stretched into the overlying surface of the left cerebellar hemisphere.

The surface of this irregular-shaped tumor had a shiny white, mother-of-pearl appearance; on the inside this glint was not present. The surface, mother-of-pearl part, was truly lamellated and permitted itself to be split into extraordinarily thin flakes. The central tumor mass fell away into irregular fragments.

The most remarkable feature in this case is the advanced age this woman reached with what was undoubtedly a congenital tumor without apparently any severe pressure symptoms intervening, although the mental derangement was probably due to a secondary internal hydrocephalus.

CASE 3. Reported by Spillman and Schmitt. From the examination these authors came to the conclusion that this was an epithelial tumor arising from the choroid plexus.

History. Man 31 years of age, a vine-grower. For two years he had headache which came on in attacks without apparent cause; dizziness especially on turning quickly; general weakness and vomiting mainly in the morning. For 6 months he suffered from transitory diplopia, difficulty in equilibration, and increasing headache.

Examination. Sensorium intact; muscle power in part retained; pupils unequal; movements and gait ataxic; vision intact and intelligence clear.

Progress. The day before death the patient developed dysphagia, left-sided hemiplegia, right-sided paresis, atrocious headache, and died rapidly in coma.

Fig. 11. Photograph of R. R. Surg. No. 11152, showing operative field.

Pathology. Mother-of-pearl tumor of hen's-egg size. On the inside looked like a piece of spermaceti. The growth pushed the cerebellar hemispheres aside, flattened the medulla, encroached upon the vermis, and was weakly attached to same. On the contrary the union of the tumor with the floor of the fourth ventricle was much firmer but was separated without loss of substance. The convex surface of the tumor was warty, with a typical mother-of-pearl sheen. Vascularization was not recognizable. It appeared dry, cut like butter; the cut surface was yellowish-white, and in the center were gray spots and little alveolar cavities.

This story is in marked contrast with the previous one. Death most certainly occurred in this case from acute stoppage of cerebrospinal fluid drainage.

CASE 4. Reported by Toché. In 1895, Toché reported a case whose history seems to follow a trauma.

History. Nine years before his death the patient fell out of a wagon against a wall, causing contusion of the head on the right side. For 8 years he suffered with gradually increasing staggering gait and tremor. For 3 years unable to walk.

Examination. Showed total inco-ordination of movement; disturbed equilibrium; left-sided facial paralysis; slight converging strabismus of left eye; slight nystagmus of both eyes, and bulbar paralysis.

Pathology. A tumor the size of a hen's egg, of cheesy consistency and crumbly appearance was found in the lower vermis of the cerebellum, in-

Fig. 12. Typical cross section of outer part of tumor, K. S. Surg. No. 10302, showing: *a*, stratum durum; *b*, stratum granulosum; *c*, stratum fibrosum; *d*, stratum cellulosum. Transitional area between *c* and *d* not shown.

volving the right cerebellar hemisphere and compressing the floor of the fourth ventricle. The light yellow exquisitely shiny mother-of-pearl tumor was sharply bounded and built out of concentrically arranged, glistening white layers. The tumor was entirely avascular and contained many fat-like bodies and cholesterin crystals.

Undoubtedly, as is usually the case, the inco-ordination resulting from the tumor was the cause of this man's accident. It is inconceivable that trauma should have anything to do with the origin of pearly tumors.

CASE 5. Reported by Bostroem. A very thorough study of one specimen was accompanied by an exhaustive analysis of the literature.

History. Little known. A woman, age 40, servant, was known to have been mentally unbalanced 9 months previous to admission, so probably had been affected for a longer time. She showed well marked alteration of character manifested by forwardness toward men. Slowly a picture developed resembling progressive paralysis, and constant mental deterioration accompanied by intercurrent megalomania. She had constant neuralgic pains over the entire body.

Examination. Sensorium practically intact but marked motor changes; well developed atrophy of the interossei and small finger musculature; tremor of the outstretched hands; unsteadiness with staggering gait; deviation on walking; dizziness when turning suddenly; speech indistinct resembling multiple sclerosis and pupils always contracted.

Pathology. She had pulmonary and intestinal tuberculosis; chronic hydrocephalus with atrophy of cerebral gyri; cerebellum of normal size. On either side of vermis were several small round bodies about 2 millimeters in diameter resembling pearls set into the upper surface of the cerebellum. The fourth ventricle was entirely filled by a typical pearly tumor which stretched 4.5 centimeters from the forward end where it was bounded by a thickened, outwardly displaced velum medullare anterior to the obex below, and 3.3 millimeters from the flattened medulla to the upwardly displaced and flattened vermis. It extended a moderate depth into each cerebellar hemisphere. The tumor was easily separated from the medulla. The surface of the tumor consisted of a mother-of-pearl appearing, distinctly laminated substance, while the interior was dry, crumbly, and grayish-white in color. The outer layers consisted of flat cells without nuclei, which gave the horn reaction to Gram's stain. The cells of the interior resembled plant cells. The outer ones contained keratohyalin granules. The inner ones were polygonal with skeletons of nuclei. The protoplasm was finely granular and contained fatty droplets. Between the cells were many crystals of cholesterin.

CASE 6. Reported by Frick. This patient came in so exhausted that localization was impossible.

History. For 2 years the patient had general body pains which latterly had disappeared. For a year or more vomiting had persisted. For 7 weeks the patient had been bedridden.

Examination. Apathetic, answering questions with poorly articulated phrases. Incontinent. Pupils reacted; corneal reflexes brisk.

Pathology. Dilatation of lateral ventricles. Fourth ventricle entirely filled by a mother-of-pearl tumor (Fig. 3), approximately walnut sized, extending 3.5 centimeters from the aqueduct of Sylvius anteriorly to the obex posteriorly and stretching upward from the floor of the much flattened medulla a distance of 2.75 centimeters, displacing the vermis

upward and giving the cerebellum a peculiarly plump appearance from above. It invaded the hemispheres 1.5 centimeters on either side. The surface of the tumor was distinctly lamellated and separated easily from the surrounding tissue. The interior of the tumor was made up of a dry, crumbly, grayish-white substance. The tumor surface bore irregular elevations one of which extended a half centimeter into the aqueduct of Sylvius distending it to a diameter of 0.75 centimeters in its posterior part.

CASE 7. Reported by Ballance. The patient was a well-developed woman of 30 years.

Complaint. The patient complains of pains in the back of the head "like knives"; a feeling of weight on the top of the head; sensation of "pins and needles" in the hands and feet; and inability to walk.

History. The patient was in good health until 2 years ago, when she staggered in walking. The difficulty in walking increased steadily, and of late she had been constantly falling. The pains in the back of the head and the other subjective sensations were only of 3 weeks' duration.

Positive findings. The patient is a well-nourished woman of medium height and sallow complexion; her mental state is dull and she is very slow in answering questions, but does so correctly. Speech is thick and indistinct, resembling that of a general paralytic. The tongue protruded in the mid-line and is distinctly tremulous. She has a staggering gait, with feet well apart and arms extended to preserve the balance. There is a constant tendency to fall to left and Romberg's symptom well marked. The muscular power in both limbs is good. Knee-jerks on both sides are exaggerated. There is slight impediment of muscular sense in the upper limbs. There is a slight but distinct tenderness to percussion and pressure over the whole occipital region. There was no nystagmus nor ocular palsy.

Progress. Death 5 days after admission from sudden respiratory paralysis.

Pathology. A large cholesteatoma projects between the lateral hemispheres of the cerebellum, growing from the situation of the fourth ventricle. The tumor has an extreme diameter of about 2 inches, was of irregularly spheroidal form, in places lamillated, and presented the pearly luster characteristic of this class of new-growth. R. C. S. Museum No. 3779 B.

CASE 8. Reported by Meyer. W. R. Meyer details one of Schulgin's cases which is included here although the greater part of the tumor lay in the lateral recess, a large extension, however, projecting into the fourth ventricle. The story is as follows:

History. The patient is 27 years of age. For four months she has had permanent headache, which is worse at night and localized principally at the back of the head. During the same time she has suffered from vomiting, which comes on suddenly without preceding nausea. At the same time deviation to the left in walking. Latterly sight began to fail.

Examination. The pupils are large; light reaction sluggish; paresis of lower branches left facial; tongue deviates somewhat to right; weakness of lower extremities from defective muscle sense; ataxia of right lower extremity; knee, Achilles, and plantar reflexes absent on both sides; lower and middle abdominal reflexes normal on right side, absent on left; cremaster normal on both sides.

Progress. During stay in hospital permanent headache, sleepiness, occasional vomiting, pulse rapid and arrhythmic were noticed.

Pathology. The skull bones are thin, dura mater tense, convolutions flattened, hydrocephalus internus. The tumor which had the form of a circumscribed knot (5.5 by 4.0 centimeters) lay with its greater part on the right side of the base of the brain between the pons, the right hemisphere, and the right occipital lobe, while the other part of the tumor extended into the much widened cavity of the fourth ventricle.

It will be noted that in all these cases the tumor was discovered at autopsy. So far as can be learned no true pearly tumor has heretofore ever been successfully removed at operation. Horsley's case, No. 245 of Tooth's report, unfortunately died of sepsis. Many operations for cholesteatomata have been reported, but they seem to me to be either extradural collections from the middle ear or, as in the case of Stenvers, epidermoids containing cholesterin crystals. Even one of Horsley's cases as reported by Tooth was certainly not a true pearly tumor, for it is described as hard and a true pearly tumor crumbles almost like a puff-ball when touched.

PERSONAL OBSERVATIONS

CASE 1. P. B. B. H. Surgical No. 10,302. Pearly tumor of the fourth ventricle with atypical cerebellar symptoms. Operation—extirpation. Recovery.

K. S., age 28, a housewife, was admitted April 15, 1910, with complaint of unsteadiness in walking, tinnitus, vomiting, headache and failing vision. Referred by William H. Trayes, Boston.

Family history. The mother died of tumor of breast, probably carcinoma. The husband gave a positive luetic history.

Past history. Forceps delivery with slight depression of skull in left frontal region.

Present illness. For 7 years the husband states that he has noticed her stagger at times.

During her pregnancy 5½ years before admission she suffered considerably from vomiting and headaches. She had a forceps delivery with a severe laceration, but went home on the twelfth day, feeling fairly well, and continued her work. The headaches and vomiting returned almost immediately and had

been present ever since. The headaches she described as mainly temporal, although sometimes occipital, more severe in the early morning. Vomiting occurred almost invariably on arising in the morning, and was rarely accompanied by nausea.

Three years before admission the patient had some difficulty in urination with pain and inability to start a flow, but after 4 months she passed a stone the size of a pea and had complete relief of bladder symptoms. For a year she had some pain in her upper teeth on the right side. For 11 months she has noticed her vision beginning to fail. About the same time she began to have a singing noise in her left ear. For 6 months she has been staggering so markedly that people remarked about it.

Five months ago she went to a hospital where a lumbar puncture was done. *She had immediately relief from her headaches which lasted for 2 months.* Wassermann test on the spinal fluid was negative. Three months ago her upper incisor teeth were extracted. Her vision immediately improved decidedly, and improvement continued until 3 weeks ago.

For the last 3 weeks, she has been increasingly unsteady and deviated to the left on walking. There was also a weakness and unsteadiness of the left hand. She had become lately very irritable, though originally very cheerful.

Positive neurological findings. The patient is a young, well-developed woman. She has no abnormality of the head except a longitudinal depression of the skull 3 centimeters in length in the left frontal region. The left fundus is normal, the right fundus shows definite obscuration of nasal margin of disc. There is slight nystagmus poorly sustained on looking to the right and left. Auditory acuity diminished in left ear. Adiadococinesia on prolonged exertion and slight ataxia in left hand. Epigastric and abdominal reflexes are absent. Romberg positive and gait staggering with perhaps deviation to left. Slight ataxia in left leg, heel to shin test. Emotional instability. Caloric test elicited very slight reaction from the right ear; very marked reaction from left.

X-ray of head negative; Wassermann negative. Caloric tests pointed to right side, other signs to left.

Diagnosis. Intracranial tumor involving cerebellum.

Operation, April 21, 1919, by Harvey Cushing. Operative note as follows: "With the patient on the cerebellar table, the usual crossbow incision was made with lateral flaps (Fig. 4). An extensive bone defect, including the margin of the foramen magnum was made without difficulty. The dura was not excessively tense. On opening the dura near the foramen a very large posterior cistern was disclosed and through the fluid in this cistern a glistening white, smooth, nodule could be seen, looking as though a pledglet of white cotton underlay the somewhat thickened arachnoid membrane. The wall of the cistern was opened and a most extraordinary appearance came into view, a typical pearly nodular, glistening, smooth growth. It was found that this growth extended down into the spinal canal so that it was necessary to remove the posterior half of the atlas and to incise the dura down to the axis. This brought into view a large nodule, passing down into the spinal canal lying directly upon the fourth ventricle. The appearance was exactly that of mother-of-pearl, with a brilliant glistening surface. The view at this stage is shown in Figure 5. The tumor, however, was of about the consistency of a somewhat hard marshmallow, so that it crushed easily, but nevertheless it was possible to free it from the overlying and but slightly adherent brain. This dissection was carried down for a long period, until it finally became evident that the growth was extremely deep. A larger part of the lesion was removed, the contents of the growth a material having the appearance and consistency of a rather dry cottage cheese, being spooned out of the cavity with a blunt spoon. It was finally possible to remove the glistening capsule of the growth from the depths. Some fragments of this capsule were photographed and reproduced in Figure 6. The surface of the growth was pliable like heavy tin foil and distinctly lamellated. The removal of the capsule left a perfectly clean, smooth-walled cavity of the fourth ventricle, a most extraordinary appearance, with a dilated fourth ventricle at the bottom of the deep hole and the distended iter through which fluid was pulsating. One could look almost into the third ventricle. Some idea of the appearance may be gained perhaps from Figure 7, a schematic sagittal section showing the size and location of the tumor, but one must needs look up into the depths really to appreciate it. There was extraordinarily little upset to the patient during this long delayed procedure and no bleeding whatsoever. The great cavity was filled with salt solution and the wound closed in layers as usual without drainage. The operation lasted fully 4 hours and the anæsthetic was very smoothly taken without the slightest upset. The usual large starch-bandage cast was applied."

Post-operative notes. The night of the operation the patient's temperature rose to 104°, but the next morning it was 99.8° and soon normal. There were no postoperative complications except a paresis of the right external rectus muscle which subsequently cleared. The cast and stitches were removed on the tenth day and no further care was required.

Discharged, May 21, 1919. Headache, vomiting, and dizziness had been completely relieved since the operation. There was a distinct paresis of the right external rectus muscle which, however, was greatly improved; there was slight nystagmus on looking to the left; diminished acuity of hearing in the left ear; heart ten beats per minute faster than on entrance; slight ataxia in left upper extremity; with tremor at times; gait somewhat unsteady but no deviation; Romberg positive; still somewhat unstable emotionally.

Subsequent note, June 20, 1919. No abnormality, except slight unsteadiness on turning quickly. Photographs taken at this time show admirably the method of concealing the operative field after a cerebellar exploration by doing the hair low on the neck. (Fig. 8.)

Subsequent note, December 18, 1919. Unsteadiness entirely disappeared.

Two points in the history may be noted: in the first place, the relief of headaches which followed the lumbar puncture. It has been repeatedly pointed out that a lumbar puncture should never be done on any patient suspected of having a subtentorial lesion. There is very often a hernia of the cerebellum into the foramen magnum, and removal of the fluid from the subarachnoid spaces of the spinal canal allows the herniated tissue to be pushed farther into the foramen causing pressure on the medulla oblongata with resulting respiratory embarrassment and even sudden death. In this case there was a solid, irregular tumor in the mid-line which did not herniate.

The second point of interest is the improvement in vision following the removal of teeth. In these days of interest in focal infection, this is not the first time teeth have been pulled for failing vision due to choked disc. In this case it seems for some inexplicable reason really to have done some good.

CASE 2. P. B. B. H. Surgical No. 11152. Pearly tumor of third ventricle. Extirpation. Recovery.

R. R., a Jewish schoolboy of 13, was admitted February 27, 1919, complaining of failing vision. Referred by Dr. John Shedd, North Conway, New Hampshire.

Chronology of symptoms. For 6 years he has had severe, frequent, frontal headaches, not accompanied by vomiting or visual disturbance. For 11 months there has been gradual failure of vision in the right eye, which progressed to total blindness in 6 months. For 6 months gradual failure of vision in left eye.

Treatment before admission. In November, 1918, a right subtemporal decompression was done by William Sharpe, of New York.

Positive findings. The head is small with no evidence of hydrocephalus. X-ray shows absorption in frontal region. The child is well nourished but not fat, being 6.64 kilograms below the standard weight for his age and 7.7 centimeters below standard height. His hands are small but not typically pituitary. The genitalia show evidence of early adolescence. There are no signs of dystrophy evident. There is blindness in the right eye and temporal hemianopsia in left. Visual acuity, left eye 10/70. Internal strabismus of right eye. Fundus on right showed marked pallor of primary atrophy; fundus of left eye very similar. There is slight nystagmus on looking to the extreme left. Wassermann and von Pirquet negative. Basal metabolism −14.

March 4, 1919, discharged. April 21, 1919, reentry. Visual acuity left eye 10/100. April 24, 1919, discharged. September, 12, 1919, reentry. Visual acuity left eye 5/100.

Operation. September 20, 1919, by Harvey Cushing: "The patient took the anæsthetic very badly, and it was 45 minutes before he could be anæsthetized sufficiently satisfactorily to justify proceeding with the operation. I was on the point of abandoning it on several occasions for a second session. The usual low right frontal flap was made, there being much less bleeding than usual. The case was one in which there were no frontal sinuses to make the outlining of the flap difficult. The dura as exposed was not tense and after reflecting it from the roof of the orbit down to the sphenoidal edge, an incision was then made through the dura close to its line of attachment, with a hooked knife. There was an abundant cerebrospinal fluid which escaped. With the idea that if a larger exposure would be necessary it would be best to puncture the ventricle, an attempt was made in three directions to insert a needle through the frontal lobe into the ventricle without success. Probably, therefore, the ventricle is not distended nor would it have been expected to be in view of the absence of pressure symptoms. After this failure to get into the ventricle the local region was further explored. The olfactory nerve on the right side was seen and lifted up with the frontal lobe and before the end of the operation was probably permanently damaged, though it was not perhaps fully divided as it is often in these operations. The entry of the right optic nerve into its foramen was seen, though the nerve where seen was reddish and appeared to be extraordinarily small. To the left of this nerve and in the space between the two clinoid processes was a greyish tangle of what appeared to be thickened arachnoid, but on entering this, the wall of a mother-of-pearl tumor was exposed with the characteristic mass of epithelial débris as its contents. With a soft pituitary spoon this material was gradually scooped out from the center of a tumor which must have been about the size of a golf ball. As the material was scooped away it was possible, as in the case of K. S., Surg. No. 10302, to remove the contents and peel away a large amount of the wall, though not as completely as in the former case. This incompleteness of getting out the wall was due to the fact that the tumor had many irregularities which projected into different regions and particularly because it was very adherent to the chiasm. In fact, the two optic nerves were more or less incorporated in the tumor. The nerve on the left was even smaller in appearance than on the right even though it was the only nerve which still transmitted slight impulses. After the tumor was as thoroughly cleared away as possible,

an extraordinary view was had of the region with the internal carotid on each side and the anterior cerebral and practically the entire Willisian circle. The removal in fact had been so complete that Dr. Bailey cautioned the operator lest he pick up by accident the third and fourth nerves. The exposure as a matter of fact must have been practically back to the pons as shown by the sketch (Fig. 9) of a sagittal section from another case of a cyst of about the same size. The large cavity was filled with salt solution and the flap replaced and closed in layers without a drain."

Postoperative notes. The patient made an excellent ether recovery and the stitches were removed on the third day as usual. The wound seemed perfect and the patient's pulse and respiration continued good but he developed a most remarkable reaction. He was very restless, rolling and tossing constantly; crying and whining incessantly. He would answer questions only after persistent effort but his answers indicated perfect comprehension. This state of affairs persisted for nearly 2 weeks at the end of which time he persisted in staying in bed curled up with his head under the covers complaining that he was cold. He would answer questions but always ended by crying. The involuntary movements of his limbs made it impossible for him to walk. There was little spasticity but definite resistance. There was no Babinski. Definite coarse tremor of both hands was present. Speech was jerky, but there was no definite dysarthria and no dysphagia. He was troubled very much by insomnia scarcely sleeping at all and crying or laughing on any stimulation. If there had been more spasticity, one might have made a diagnosis of lenticular lesion. The condition must have been due to some disturbance of the circulation to his basal nuclei following collapse of the brain on removal of the tumor. The symptoms gradually disappeared until by the end of the third week he was normal again. Immediately after the operation his vision was very poor, but it was impossible to make a good examination because of his extreme restlessness. At the end of the third week his visual acuity had returned to 5/200 and the field to nearly preoperative extent. His temperature remained above normal until the nineteenth day.

Discharged, October 20, 1919, perfectly well except for eyes. Figure 11 taken at time of discharge shows well the operative incision.

There was considerable doubt as to the wisdom or propriety of operating in this case. There were practically no pituitary symptoms and the sella turcica was normal. With blindness in one eye it was impossible to prove that he had not had a homonymous hemianopsia. Furthermore, his mother insisted that we give a perfect prognosis both as to vision and life before operating. So he was twice discharged before operation was finally undertaken.

PATHOLOGICAL NOTES

Histological examination proved conclusively that both these cases were true pearly tumors. It is hoped that reference to Figure 12 will make the histological description clear. The tumors were very fragile, and great difficulty was experienced in getting good sections. The histological picture varied a great deal also in different parts, especially in the thickness of the various layers. An attempt was made to reproduce a typical cross section of the wall of the tumor.

The outer part of the tumor divides itself quite definitely into layers which I have termed from without inward; stratum durum, stratum granulosum, stratum fibrosum, and stratum cellulosum. The stratum granulosum is the most constant in thickness. It consists of from two to four layers of flattened cells containing well formed nuclei and definite cell boundaries. In the cytoplasm, numerous fine granules may be demonstrated by the usual stains used for keratohyalin. The following procedure gave the best results: fix in 80 per cent alcohol, embed in celloidin, section 10 μ in 80 per cent alcohol, water, 1 per cent aq. sol. Kresyllichtviolett 5 min., 95 per cent alc. 2 changes 3 min. each, abs. alc. 3 min., clear in oil origanum, mount in balsam. The inner layer of cells contains by far the greater number of granules. The general cytoplasm of these cells also takes the stain lightly. Eleidin granules could not be demonstrated.

The stratum durum varies from one to five or six times the width of the stratum granulosum. It consists of a homogeneous material for the most part quite structureless. At places it seems to split longitudinally and at others is broken into irregular fragments, but cell boundaries are nowhere visible. There are occasional bodies shaped usually like multipolar nerve cells which take nuclear stains heavily. No definite nuclear structure can be made out but it seems they must be pyknotic nuclei for at places they appear to be straggling out from the stratum granulosum. It is this layer which has the beautiful sheen so characteristic of the tumors. It easily splits off from the main body of the

tumor but always carries with it the stratum granulosum.

Beneath the stratum granulosum lies the stratum fibrosum which consists of layer after layer of a homogeneous material. These sheets may be easily separated one from another. No evidence of cell boundaries has been found and there are no nuclei. This stratum ends abruptly at the stratum granulosum, but on the other side gradually gives way to the next layer.

The stratum cellulosum makes up the bulk of the tumor. It consists of a mass of polyhedral cells. The cell boundaries are quite plain, in fact so marked that the cells have often been compared to plant cells. The cytoplasm is granular and contains many fatty droplets. Scattered around in the tumor from the third ventricle were numerous cholesterine crystals. It is interesting also that there were numerous cholesterine crystals on the outside of this tumor. Thorough search failed to reveal any cholesterine crystals in the other case. The cells contain skeletons of nuclei which do not take nuclear stains.

The question of the origin of these growths cannot be settled from an examination of these two cases. The histological picture certainly suggests epithelium. The presence of the stratum fibrosum free from nuclei or other cellular structure between stratum granulosum and stratum cellulosum is rather difficult to explain. The origin of the stratum durum from cornification of the cells of the stratum granulosum may be accepted. It may be that the stratum fibrosum contained cells similar to the stratum cellulosum which were flattened out after they were dead and their cell structure destroyed. The stratum granulosum whose cells were already undergoing cornification would be resistant and retain some cellular structure.

The whole mass is certainly quite dead, apparently growing to a certain size and choking itself out, then lying dormant for years, until for some reason an obstruction to cerebrospinal fluid drainage arises, when acute symptoms intervene.

BIBLIOGRAPHY

BALLANCE. Some Points in the Surgery of the Brain and its Meninges. Macmillan. 1908, Fig. 63.

BENDA. Zwei Faelle von Cholesteatom des Gehirns. Berl. klin. Wchnschr, 1897, xxxiv, 8.

BENEKE. Ueber der Histogenese der pialen Cholesteatome. Schmidt's Jahr., 1897, cclvi, 116.

BERNHARDT. Beitraege zur Symptomatologie und Diagnostik der Hirngeschwuelste. Berlin: 1881.

BINDER and SCHWALBE. Ein Cholesteatom des Gehirns. Verhandl. d. deutsch. path. Gesellsch., Jena, 1909, 325-332.

BOSTROEM. Ueber die pialen Epidermoide, Dermoide und Lipome, und duralen Dermoide. Centrlbl. f. allg. Path. u. path. Anat., 1897, viii, 2.

CHIARI. Ein Cholesteatom des Rueckenmarkes. Prag. med. Wchnschr., 1883.

COENEN. Ueber das Cholesteatom des Nabels. Beitr. z. klin. Chir., Tuebingen., 1908, lviii, 718-721.

CRUVEILHIER. Anatomie pathologique du corps humaine. vol. i, book 2, plate 6.

DEMALE. Soc. méd. de Genève, 1918. (Not available.)

DUMÉRIL. Bull. Soc. Faculté de Méd., 19 février, 1807.

FRANK, C. Ueber einen in der Duerener Irrenanstalt beobachteten Fall von Cholesteatom. Allg. Ztschr. f. Psych., 1890, xlvi, 30.

FRANK, H. Ein Fall von Cholesteatom der weichen Hirnhaeute. Inaugural Dissertation, Marburg, 1892.

FRICK. Ein Fall von Cholesteatom im IV. Ventrikel. Frankf. Ztschr. f. Path., Wiesb., 1910-1911, vi, 207-220.

LAUER. Four new Kharkov cases of cholesteatomata of the brain. Kharkov Med. Jour., Russia, 1915, xix.

MARIE and ROUSSY. Un cas de cholesteatome de la base de l'encéphale. Rev. neurol., Par., 1905, xiii, 1183.

MEYER. Zur Kasuistik der epidermoidalen Cholesteatome des Gehirns. Arch. f. path. Anat., etc. Berl., 1913, ccxi, 161-165.

MUELLER. Ueber den feineren Bau und die Formen der Krau chaften Geschwuelste, 1838, p. 50.

NEHRKORN. Ein Fall von meningealer Perlgeschwulst. Beitr. z. path. Anat. u. allg. Path., 1897, xxi, 73.

SCHOLTZ. Einige Bemerkungen ueber das meningeale Cholesteatom in Anschluss an einen Fall von Cholesteatom des III. Ventrikels. Arch. f. path. Anat., etc., 1906, clxxxxiv, 225-273.

SCHULGIN. Two cases of cholesteatoma in the region of the fourth ventricle of the brain. Sovrem. Psikhiat., Mosk., 1911, v, 143-163.

SPILLMAN and SCHMITT. L'étude des tumeurs du quatrième ventricule. Arch. gén. de méd., 1882, ii, 182.

STENVERS. Ein cholesteatom van de schedelbasis voor en na de operatie. Nederl. Tijdschr. v. Geneesk., Amst., 1918, i, 1739.

STRAUSS. A case of cholesteoma of the brain. J. Nerv. & Ment. Dis., N. Y., 1913, xl, 257.

TOCHÉ. Étude sur deux cas d'endothéliome du cervelet. Thèse de doct., Paris, 1888.

TOOTH. Treatment of tumors of the brain and the indications for operation. Proc. XVII. Internat. Cong. of Med., Lond., 1913, Sect. xi, discussion No. 4.

THURMAN. Cholesteatomatous tumor of the brain. Tr. Path. Soc., Lond. 1854, v, 21.

VERSE. Zwei Faelle von Cholesteatom der Hirnbasis. Muenchen med. Wchnschr., 1918, lxv, 224.

VIRCHOW. Ueber Perlgeschwuelste. Arch. f. path. Anat., etc., Berl., 1855, viii, 371-418.

DEPARTMENT OF TECHNIQUE

INGUINAL HERNIA

By D. FOLDES, M.D., Cleveland, Ohio

HERNIOTOMY is one of the most commonly practiced operations. Although it is considered to be one of the simplest operations, this supposition is not borne out in practice. There are recurrences no matter what method is used and I agree that being able to do one method well is better than using the best method incorrectly. Still there are many times when a surgeon must deviate from his regular technique, and I feel confident that many recurrences can be avoided if the surgeon is thoroughly acquainted with the anatomy of the inguinal region and with different methods for the closure of the inguinal triangle and if he will close the canal according to the anatomical findings in a given case.

In 1899, Bloodgood (1) advised the incision of the sheath of the rectus muscle for the purpose of mobilization, and in a small number of cases he used the rectus and its sheath in closing the inguinal canal. In 1918 (2) Bloodgood again called attention to cases in which the conjoined tendon was absent and advised closing the defect with the rectus muscle and its incised sheath, doubling the aponeurosis above the cord. In the case reported, the cord was not transplanted; therefore, the cord passed through the small opening which remained in the lowest corner. At this point recurrence is likely to take place, but recurrence can be avoided if the cord is transplanted in such cases.

In 1905, Polya (3) published an article entitled, "Modification of the Bassini Operation for the Radical Cure of Inguinal Hernia." In this article he discussed the weak points of the Bassini operation; viz., the possibility of recurrence at (1) the lower angle of the inguinal canal, and (2) at the point at which the cord enters the canal. However exact the ligation may be, the sac after ligation remains in the vicinity of the spermatic cord, and there is therefore the possibility of recurrence. Clinical experience shows that nearly all the recurrences take place at these two places.

Several methods have been devised to prevent recurrences along the cord, either by reducing the thickness of the cord (Halsted leaves only the vas deferens with the concomitant artery and vein and resects the rest of the vessels) or by displacing the cord. Polya advised the displacement of the cord higher than its entrance into the canal, so that the cord, after leaving the internal ring, would pass upward and then with a sharp turn would pass downward. This he accomplished by displacing the cord higher, first with the Bassini suture, then with the inner flap of the aponeurosis, which is placed below the cord and serves to strengthen the Bassini suture. He covered the cord with the lateral flap of aponeurosis taking care that the cord should run in a fairly narrow canal. For this reason, he resected the vessels of the cord as advised by Halsted. He also cut the sheath of the rectus in the lower angle of the inguinal canal and sutured the rectus thus mobilized to Poupart's ligament as had already been advised by Bloodgood, Berger (6), and others.

There exists hardly any doubt that the so-called conjoined tendon is relaxed and practically useless in every case of direct hernia; in fact, this relaxation is responsible for the formation of the hernia.

Polya's investigations both on the cadaver and the living have demonstrated that in most cases in order to avoid recurrences, not only in direct but also in indirect herniæ, the only tissues strong enough for the building of the posterior wall of the canal in the lowest corner of the inguinal triangle, are the rectus and pyramidal muscles and that especial attention must be paid to this region and to the point at which the cord passes through the internal ring. To determine the relation and define the deviations of these muscles, Polya (4), in 1906, made a study on cadavers, of the anatomy of the inguinal canal, for from a surgical standpoint these muscles play an important rôle in the radical closure of hernia, as they furnish the plastic material.

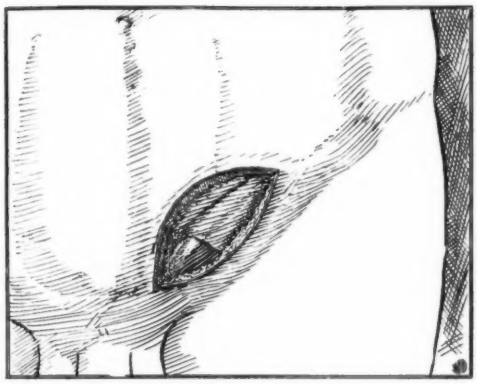


Fig. 1. A line of incision in aponeurosis.

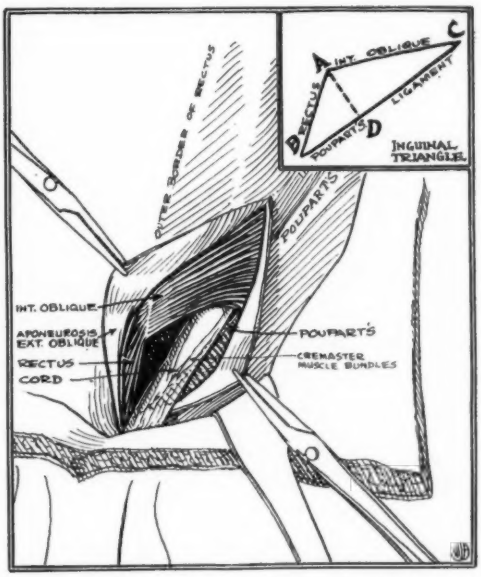


Fig. 2. Relation of muscles in the inguinal region.

From these investigations Polya concludes that the lowest portion of the internal oblique muscle is in most cases not satisfactory for the radical closure of the inguinal canal either because this part of the muscle is weakly developed or because it is absent in the lower angle of the triangle. Therefore the muscles which must be used are the rectus and the muscular part of the internal oblique and transversalis. Polya called the border of the muscular portion of the internal oblique the "true border" of the oblique muscle.

The three important structures therefore are: the rectus, the true border of the internal oblique, and Poupart's ligament. These structures form a triangle. The object of the radical operation is to unite the sides of the triangle into one line. The difficulties encountered in obtaining this result depend upon the configuration of the triangle and upon the fixation of the sides.

In 1911, in operating upon patients for inguinal hernia, Polya (5) endeavored to determine the configuration of the inguinal space and the relation of the configuration to the type and size of the hernia. One hundred herniæ were examined in 80 persons, the ages varying from 10 to 70, the duration from 3 months to several years, the size from incipient to as large as the head of a man, in some cases reaching even to the middle of the thigh.

Measurements taken were: (1) the length of the rectus included in the formation of the inguinal space, i.e., the distance between the pubic bone and the point were the rectus and the true border of the internal oblique muscle meet; (2) the length of the true border of the internal oblique muscle from Poupart's ligament to the rectus, not considering the weakly-developed bundles; (3) the length of Poupart's ligament from the internal oblique to the pubic bone.

These measurements were not so exact as obtained on the cadaver where the structures can be dissected and measured accurately; therefore, the measurements are only of relative value and because the measurements are not exact the fractions have been omitted. Most important in his findings is the determination of the length of the rectus included in the inguinal space because mobilization of the rectus is more difficult than mobilization of the other muscles in this space. Therefore, the length of the rectus is to some extent the index to the difficulties to be encountered in the closure. It is the easiest to determine and therefore the most accurate among the measurements. In the 100 cases examined, the length of the rectus was found to be as follows:

In 1 case, no centimeters;
In 7 cases, 1 centimeter;
In 31 cases, 2 centimeters;
In 28 cases, 3 centimeters;
In 17 cases, 4 centimeters;
In 9 cases, 5 centimeters;
In 5 cases, 6 centimeters;
In 2 cases, 7 centimeters.

From these measurements it can be seen that there was only one case, an incipient, indirect

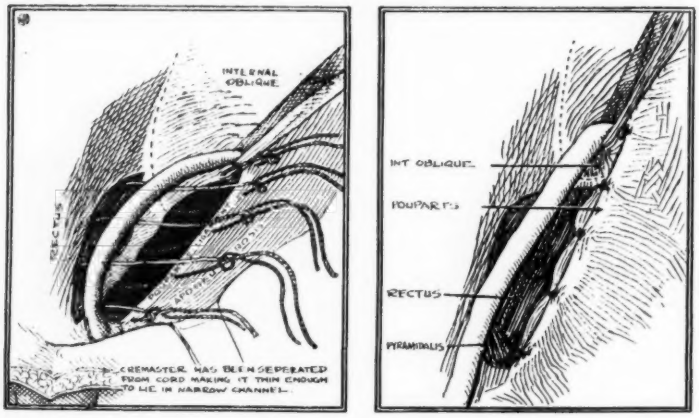


Fig. 3. At left, anterior sheath of rectus split; sutures in place. At right, Bassini sutures tied; cord displaced upward.

hernia, in which the rectus muscle was excluded from the formation of the inguinal space. In this case, therefore, the space was not a triangle but a simple fissure. These measurements also show that in most cases the rectus plays an important part in the construction of the inguinal canal. In the majority of cases examined it was 2 to 3 centimeters in length, but there were many cases in which it was more than 3 centimeters. It was an exception to find the internal oblique muscle so well developed down to the pubic bone that it excluded the rectus.

Polya concludes that one of the important requirements for the radical closure of the inguinal canal is the suturing of the rectus to Poupart's ligament, as had already been advised by Bassini in certain cases. This is more difficult than to suture the internal oblique muscle, partly because the rectus does not run in so nearly a parallel line with Poupart's ligament as does the internal oblique; partly and mostly because the sheath of the rectus is a very strong and resistant structure and is firmly attached to the symphysis and to the ribs; and also because the rectus fuses with the linea alba. It must be remembered also that the greater the part the rectus plays in the triangle the more difficult it is to unite the internal oblique with Poupart's ligament, because then the true border of the internal oblique is more distant from Poupart's and is fixed higher to the rectus sheath. The tension of the muscles is the greatest at the point where the true border of the oblique muscle meets the rectus. The perpendicular line drawn from this point to Poupart's ligament is the best index for the difficulties encountered in each given case.

Polya's experiences in recurrent herniæ are similar to those of other surgeons. The recurrence is most frequently in the lower corner of the canal, between the rectus and Poupart's ligament. This is also a proof that the cause lies in failure to use the rectus muscle or in failure to mobilize it.

Polya points out four types of recurrences: (1) those showing diffuse scar formation and stretching of the muscles and tendinous structures comprising the inguinal canal, as is seen after suppurations; (2) those showing an entire absence of union between muscles and Poupart's ligament, every structure appearing to be intact as if no operation had been performed; (3) those showing the stretched and upward drawn Poupart's ligament grown to the muscles as if pushed up by the recurrence, or those in which the recurrence occurs below Poupart's ligament as in femoral herniæ; and (4), the most frequent form, those showing union in the lateral part of the inguinal canal between the muscles and Poupart's ligament with a defect in the medial corner. Recurrences in group 4 are due either to failure to suture the rectus to Poupart's ligament, or if sutured, to failure of the suture to hold at this point where the tension is the greatest, due perhaps to imperfect mobilization of the rectus or to the early absorption of the suture material or to the cutting through of the suture before union has taken place.

As mentioned before the difficulties encountered in mobilizing the rectus are due to the firm and

tense sheath of the rectus. This tense, firm sheath of the rectus also prevents the internal oblique muscle, which is fused with it from being pulled down even in patients in whom the length of the rectus is only 2 or 3 centimeters, as is the case in most patients. This difficulty is found even more often when the rectus is longer. Therefore, if one wishes to close the canal firmly and without tension, he must overcome this obstacle by incising well the rectus sheath, a step which Polya has been practicing for many years.

The Bassini operation with the modifications described and explained above, is the operation of choice for direct herniæ where the tissues in the lower corner are either weak and pushed apart or stretched and therefore unable to stand tension. When the cord is not displaced at the first operation, recurrence is in the form either of a direct hernia or of an indirect hernia in which the sac in following the cord becomes elongated and finds its way through the opening left for the cord.

In nearly all hernia operations, the author follows the Bassini technique as modified by Polya including the steps advocated by Bloodgood, Halsted, Berger, and others. The steps of the operation include:

1. Incision of the skin and the subcutaneous tissue. Careful exposure of the external ring and the aponeurosis.

2. Incision of the aponeurosis, beginning in the inner corner of the arc of the ring (Fig. 1) so as to have a larger lateral flap and a smaller medial flap of the aponeurosis. The reason for this step will be explained later in the reconstructive technique. The inguinal canal is well exposed, particular attention being paid to expose the edge of Poupart's ligament and the rectus muscle.

3. The cord is lifted out of its bed without pulling on its distal end so as not to disturb the scrotal part of the cord and the testis. If these parts are disturbed, however, it does not cause much trouble. The cremaster is separated from the cord to make the cord thin enough to lie in a narrow channel. A tape is inserted under the cord to act as a tractor. An incision is made over the cord parallel with the vessels in order to expose the peritoneum which is then caught with a forceps and in most cases opened. If possible, the contents of the sac are reduced before opening. The left index finger is introduced and the distal part of the sac elevated, and while the assistant is holding the cord quietly, tension is made which enables the operator to make long incisions down to the peritoneum and far away from the cord, avoiding injury to the vessels.

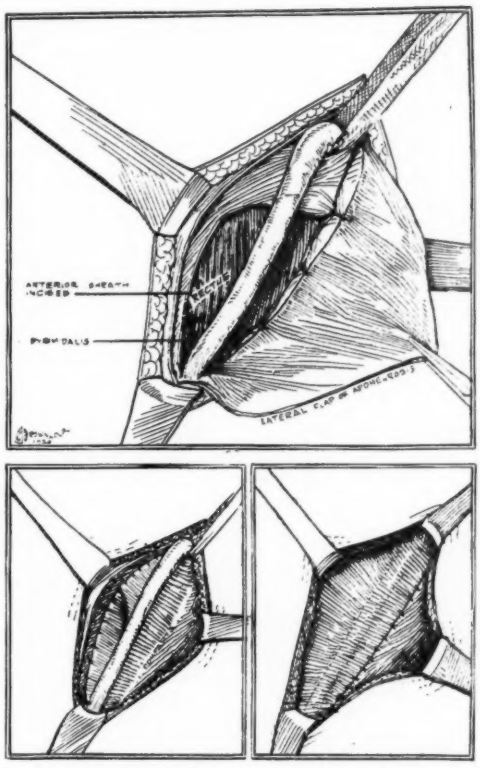


Fig. 4. Above, before suturing lateral flap of aponeurosis. At left below, lateral flap of aponeurosis sutured to the sheath of the rectus; closing the incised slit in rectus and displacing the cord higher. At the right below, the cord is covered with the internal flap of the aponeurosis.

This sharp separation of the sac from the cord saves the vas deferens from injury. The sac must be separated as far as the epigastric artery. This is one of the important steps in hernia operations. After resection and ligation of the sac the reconstructive part of the operation commences. It is worth while to mention that the preperitoneal fat found on the cord has to be separated and ligated. If one fails to find a sac in an incipient hernia, one should never fail to look for the sac in this fat. No doubt the sac will be there and it must be separated, however small it may be. If the sac is well separated it will be seen to withdraw suddenly and not remain in view.

4. The relation of the muscles to Poupart's ligament is investigated (Fig. 2) and if the rectus is found to participate in the formation of the inguinal triangle, its anterior sheath must be

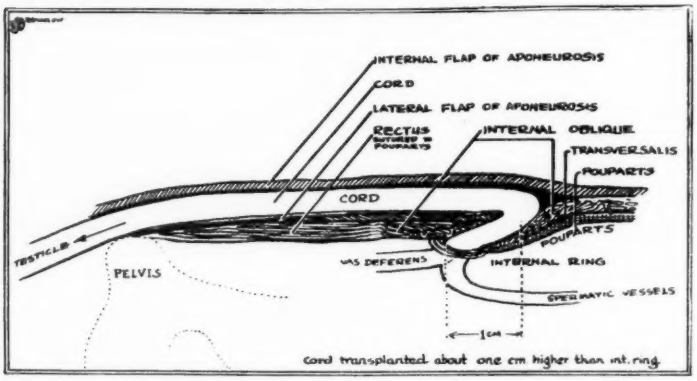


Fig. 5. Schematic drawing of cord transplantation.

incised from 3 to 6 centimeters to mobilize it (Fig. 3). This will relieve the tension on the suture and will allow the important lower angle of the canal to be closed with a firm structure, the rectus and pyramidal muscles. I incise the sheath after placing and tying all sutures, thus preventing the tearing of the rectus muscle. This can not be done, however, when the distance between the rectus and Poupart's ligament is too great, because the rectus will not yield without the incision of its sheath before tying it. I place all the Bassini sutures first and then tie them, beginning with the one where the distance between muscle and Poupart's is the shortest. All sutures are placed below the cord. The uppermost suture in the internal oblique and transversalis muscles to Poupart's is placed in such a way that when tied the cord is displaced higher.

Important points in the technique at this step are: (a) The inclusion of Gimbarnat's ligament in the lowest corner. The needle must be felt against the bone. (b) The inclusion of the edge of Poupart's ligament in the suture as well as its middle part. (c) As Poupart's ligament tears easily, when inserting the needle into the ligament the needle should be passed so as to follow the curve of the needle, not making a sideward excursion with it. (d) When tied the muscle must always be drawn to Poupart's ligament instead of drawing Poupart's ligament up to the muscles. This is accomplished through mobility of the muscles and the correct placing of the sutures. If Poupart's ligament is drawn up to the muscle, it might give rise to the formation of a hernia below. The object of the fourth step is to build the posterior wall of the canal (Fig. 3). This is accomplished by uniting in one line the inguinal triangle formed by the rectus, the true border of the internal oblique and Poupart's ligament. As a rule four single sutures are sufficient. The wall should be examined for any defect and sutures placed where needed.

5. To strengthen the posterior wall of the canal and to displace the cord higher without producing tension on it, the lateral flap of the aponeurosis is sutured to the internal oblique and the rectus muscles, passing under the cord (Fig. 4). The displacement of the cord is accomplished by the uppermost suture in this flap. If possible the hiatus in the anterior sheath of the rectus should be covered with this flap of aponeurosis. Continuous catgut is used for this step. It is for this purpose that the aponeurosis is incised in such a way as to get a larger lateral flap. Instead of the external flap the inner flap of the aponeurosis can be used and sutured to Poupart's ligament. In this case the inner flap must be larger than the lateral. Care must be taken not to displace the cord so much as to cause tension on it or pull up the testis from its place.

6. The cord is placed on the wall thus prepared and covered with the internal flap of the aponeurosis (Fig. 4). This canal of the cord should be narrow but not so tight as to cause congestion. If the cord is too thick, it should be stripped from most of the vessels (Halsted). I have found this necessary only in a very few cases.

7. The skin incision is sutured with silkworm-gut and black thread.

All bleeding must be controlled very carefully during operation. Collodion dressing is applied to the wound by placing one layer of gauze in collodion and covering the wound with it. No

other dressing is necessary. The advantage of the collodion dressing is that the wound can be controlled better without disturbing the patient, and there is no danger of infection because the wound is sealed perfectly. If there is pus or inflammation in the wound, it can be readily seen and the collodion dressing removed only at a distance needed. To the infected territory, gauze dressing is then applied. The scrotum is always suspended for 24 to 48 hours.

I do all hernia operations under local anæsthesia if the patient consents to it, using one-half per cent novocaine-adrenalin solution. The solution is always prepared fresh before the operation. The base of the solution is the following: Sodium chloride, gram 7.0; potassium sulphate, gram 4.0; aquæ destill. 1000.0 gram; and dil. hydrochloric acid, minims II. I wish to state that I have used this solution since 1914, and I have noticed that while it is necessary to wait a little longer for the anæsthesia to take effect, it is more reliable, stronger, and lasts longer. The potassium sulphate enhances the effect (Hoffmann and Kochmann). The tablets are always boiled before using in a container of Jena glass or porcelain. The hydrochloric acid serves to prevent decomposition of the adrenalin. If these precautions are observed the solution will remain clear, and toxic symptoms will be prevented unless technical errors occur.

Braun's technique for nerve blocking is followed. The technique is simple and perfect anæsthesia can easily be obtained. I have used the direct infiltration method and have been able to get good anæsthesia in most cases. Occasionally I have had to inject the nerves after exposure. Nerve blocking anæsthesia is more reliable, especially with the operative technique described, and is not more difficult than direct infiltration. Anæsthesia is established over a larger area than with the direct infiltration method. The amount of the solution required is slightly more, 70 to 75 cubic centimeters, while 40 cubic centimeters is used with the direct infiltration method.

Many patients wish to witness the operation and as they suffer no pain the mind is relieved. Fewer assistants are needed as the anæsthetist is eliminated. After the patient is in bed there is no need to have a nurse watch the patient as is necessary after narcosis. During the operation, if it is difficult to detect the sac, the patient can help by pressing, as pressure makes the sac protrude. The firmness of the wall constructed and the sutures can be tested by a similar act of the patient. The patients receive liquids soon after they reach the bed. The patient is not distressed with vomiting. There is not so much tension on the sutures because the patient does not press upon the muscles as he does before waking up from the narcosis. The pain in the wound starts 2 to 3 hours and sometimes 4 to 5 hours after operation and there are cases when but very little pain is felt. Pain due to distention of the bladder 3 to 5 hours after operation is relieved after the patient voids.

I have participated in the operation and have operated upon several hundred herniæ in which local anæsthesia has been used and I have not seen ill effects due to the anæsthesia. Morphine is not used. Vomiting occurred during and after operation only when morphine had been given before operation.

The patient stays in bed 5 to 8 days, the stitches are removed on the seventh to eighth day, and full diet is given 48 to 72 hours after operation. The patient is allowed to move his legs after the operation and is allowed to sit up on a backrest on the day of operation if he so wishes.

Pain which is sometimes complained of in the operative region and which persists even several weeks after operation, can be prevented, if care is taken not to include the nerves when placing the Bassini sutures.

Recurrences follow every method but I believe that if the surgeon knows the anatomy of the inguinal canal and employs the technique just described, recurrences will be fewer. If suppuration sets in after operation, the method of closure cannot be considered the cause of the recurrence. If there is suppuration it is due to faulty technique and not to the local anæsthesia.

To follow up every case of hernia (as well as any other cases), it would be advisable to present every patient when leaving the hospital with a card stating briefly the diagnosis, the operative findings, the technique used, the name of the hospital, and the surgeon. Patients do not always return to the same surgeon in case of recurrence; therefore recurrences cannot be followed. If the patient has the card described and presents it to the doctor he consults or the hospital he enters, it should be incumbent upon one of them to notify the first operator of the findings at the second operation. This courtesy might easily be established by a mutual understanding.

REFERENCES

1. Bloodgood, J. C. John's Hopkins Hosp. Rep., 1899, 277.
2. Idem. Southern M. J., 1918, xi, No. 5.
3. Polya, E. A. Centralbl. f. Chir., 1905, No. 9.
4. Idem. Orvosi Hetilap, Budapest, 1906, No. 38.
5. Ibid., 1911.
6. Berger. Rev. de chir., 1902, xxv.

THE THREE-FORCEPS AND FOUR-FORCEPS KNOT

By ROBERT EMMET FARR, M.D., F.A.C.S., Minneapolis

IN the tying of ligatures, during a surgical operation, it is desirable to use methods which conserve ligature material, eliminate handling of the ligatures by the gloved hands, facilitate tying in deep, narrow cavities, and possess the attribute of speed. The forceps tie described by Grant, in SURGERY, GYNECOLOGY AND OBSTETRICS, May, 1918, page 559, possesses these attributes to a greater degree than does any method with which I am familiar. The method of Grant is shown in Figures *a*, *b*, *c*, and *d*, Plate I. To complete the knot the forceps in the operator's right hand, Figure *b*, Plate I, is placed beneath the ligature instead of above it.

The methods which I have devised, namely the "three-forceps" tie and the "four-forceps" tie, are illustrated in Plates II and III, and are simply an amplification of the method of Grant.

THE THREE-FORCEPS TIE

The "three-forceps" tie utilizes the assistant's hand, one of which is usually free. The technique is as follows: After the first portion of the Grant knot is tied, the assistant presents the forceps, Figure *a*, Plate II, preferably with the point directed toward the operator's face. The operator then loops the ligature about the assistant's forceps, Figure *b*, Plate II, and "feeds" the short end of the ligature to the assistant, Figure *c*, Plate II. The assistant then simply makes taut the short end, Figure *d*, Plate II, while the operator draws the ligature over the end of the assistant's forceps and forces the knot home. In working in deep cavities, the operator may assist in completing the knot by making pressure upon the short end of the ligature with the needle holder, which he holds in his right hand, Figure *d*, Plate II.

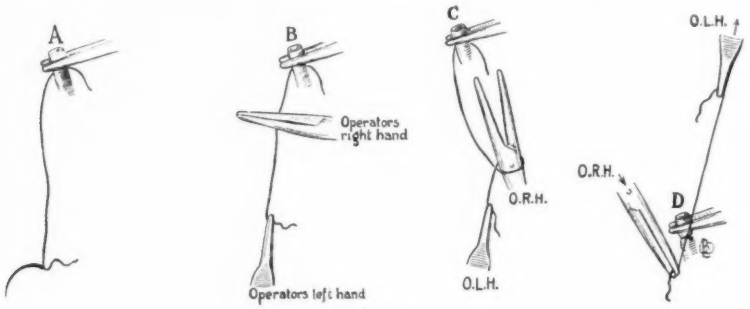


Plate I

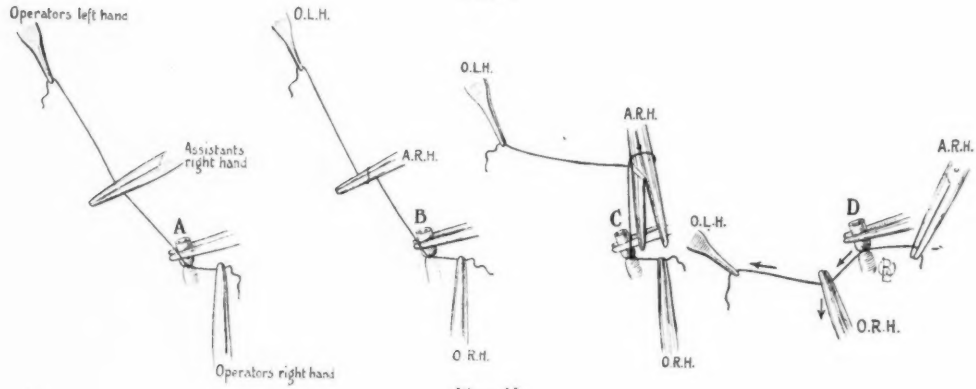


Plate II

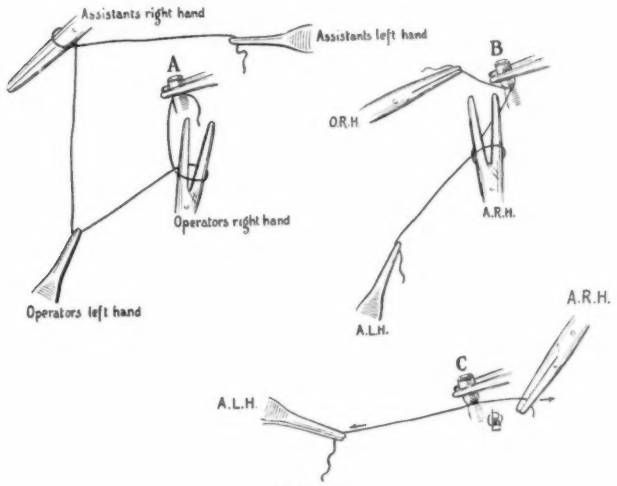


Plate III

THE FOUR-FORCEPS TIE

The "four-forceps" tie is simply a duplication of the Grant knot, except that while the operator is tying the first portion of the knot the assistant prepares for the second step, Figure *a*, Plate III. By the time the operator has completed the first half of the knot, Figure *b*, Plate III, the assistant is ready to grasp the short end and complete the knot, Figure *c*, Plate III. In case it is thought advisable to lock any of these knots, a second revolution of the ligature may be made about the forceps.

THE USE OF DOUBLE THREAD IN SURGICAL WORK

By KENELM H. DIGBY, M.B., B.S. (Lond.), F.R.C.S. (Eng.), Hong Kong, China
Ho Tung Professor of Clinical Surgery, University of Hong Kong; Honorary Visiting Surgeon, Government Civil Hospital, Hong Kong

IT is a good general principle that the less the fingers touch the wound, the needle, or the sutures during an operation the better. Rubber gloves are not complete protection against hand infection. Even if a new pair of gloves is used for each operation, there is risk of puncture if needle and thread are manipulated by the surgeon's finger. It is unpleasantly surprising to find how often gloves leak when tested after operation.

Where suppuration would be especially dangerous, as in certain operations upon bones and joints, it has always been found that a "no hand touch" technique has had to be adopted. In performing intestinal anastomoses the gloves of the surgeon should not touch the needle or the thread which have picked up infection from the bowel. And even in such clean straightforward operations as those for inguinal hernia, sepsis occurs in a very small but still definite percentage of cases. So that if "no hand touch" technique can be simplified and improved so as to be less time-consuming and tedious, there is little doubt that it will come to be employed to a greater extent, although the value of tactile sensation will always necessitate the direct use of the gloved hand in many operative procedures.

A great step in the simplification of the "no hand touch" technique has been the rapid method of tying a reef knot by the use of forceps only, which was first described by Grant.[1] The present note puts forward the use of double thread as another means of facilitating and expediting the procedures in "no hand touch" technique.

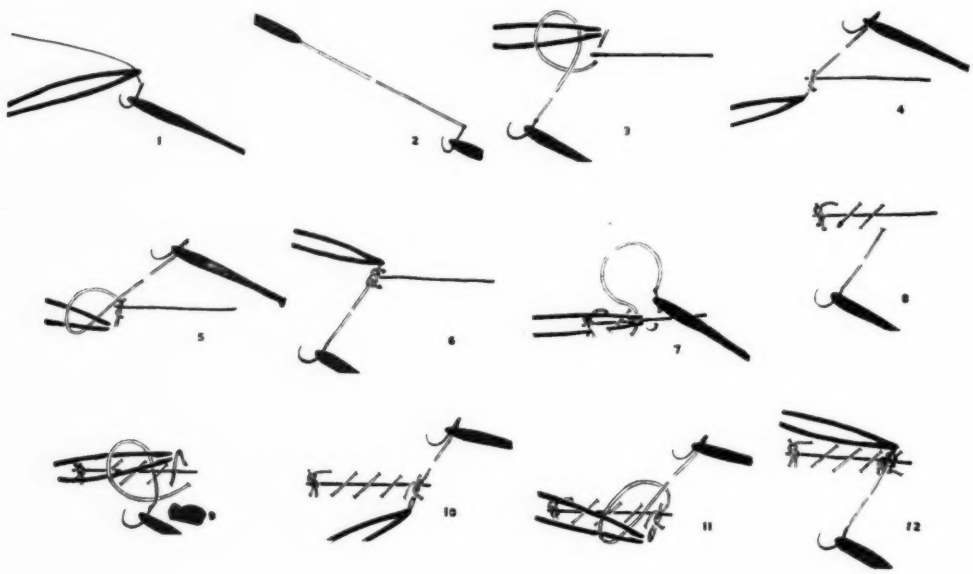
The needle held by a pair of pressure forceps is threaded with a fine, soft ligature held in a pair of dissecting forceps (Fig. 1).

The thread is then doubled by making the two parts of equal length and grasping their free ends in another pair of pressure forceps (Fig. 2).

The first stitch is made and the double thread pulled through except for the last half-inch. The pressure forceps is then removed from the free ends.

A reef knot is then tied by a slight modification of Grant's method. Dissecting forceps are placed on the short-ends side of the long, double thread.

[1] Grant. Surg., Gynec. & Obst., xxvi. 559.



The forceps-borne needle with the long double thread is next swept in a loop round the dissecting forceps (Fig. 3), which is then at once made to grasp the extremities of the short ends.

The first part of the reef knot is then drawn tight by pulling with the dissecting forceps and the pressure forceps (Fig. 4).

Again the dissecting forceps are placed on the short-ends side of the long double thread. Once more the forceps-borne needle with the long double thread is swept in a loop round the dissecting forceps (Fig. 5), which is then at once made to grasp the extremities of the short ends.

The second part is then drawn tight by pulling with the dissecting forceps and the pressure forceps, thus completing the reef knot (Fig. 6).

The continuous suture is next carried on from left to right (Figs. 7 and 8).

Finally, the second reef knot is tied much as before. Dissecting forceps are placed on the short-loop side of the long double thread. The forceps-borne needle with the long double thread is swept in a loop around the dissecting forceps (Fig. 9), which is then at once made to grasp the short loop.

The first part of the reef knot is then drawn tight by pulling with the dissecting forceps and the pressure forceps (Fig. 10).

Again the dissecting forceps are placed on the short-loop side of the long double thread. Once more the forceps-borne needle with the long double thread is swept in a loop round the dissecting forceps (Fig. 11), which is at once made to grasp the short loop.

The second part is drawn tight by pulling with the dissecting forceps and pressure forceps, thus completing the terminal reef knot (Fig. 12).

The use ot the double thread is especially valuable in that it obviates the necessity of direct handling of needle and thread, and that surgeon's fingers and thumbs can be kept well away from the wound, thus not obscuring his vision of the part. But at any time, even if direct handling of the needle and suture is employed to some extent, the double thread method has one great virtue: the needle cannot come unthreaded.

FURTHER OBSERVATIONS IN CORRECT RHINOPLASTY[1]

By LEE COHEN, M.D., Baltimore, Maryland
Work Done at the Nose and Throat Clinic, Hebrew Hospital, Baltimore,

OWING to the increasing interest shown by rhinologists in correction of nasal deformities, one no longer feels impelled to preface a discussion of this kind with an apology or offers reasons for doing such work. Corrective rhinoplasty now takes its proper place in surgery along with operations for strabismus and other facial blemishes which detract from the personal appearance of an individual and cause usually great self-consciousness and much mental depression.

In several previous monographs (2, 3, 4, 5) practically all types of deformities except the grossly over-sized or rhinomegalic nose were discussed. It shall, therefore, be the main purpose of this paper to consider the management of such a type.

The rhinomegalic nose, as a rule, is of congenital origin, and often many members of the same family are afflicted with misshapen noses, disproportionately large in comparison with other features of the face. Generally both bony and cartilaginous framework are affected. The oversize may, however, be confined to either portion alone. Bony enlargement may manifest itself in an increased dorsal prominence, with or without hump, or width at the base may also be greatly exaggerated. The bridge may be smoothly rotund, or it may at the same time be beset with ridges, offsets and other irregularities due to exostoses following trauma in early life. Then, too, displacement from the middle line of the face may exist, as a result of complete fracture of the nasal bones.

The cartilaginous nose may present a very broad tip with flaring alæ, or a drooping, pointed, and prominent tip with flattened alæ. In both instances the nostrils appear unduly large, being broad in the first instance, very long and narrow in the latter. The very long nose may be due mainly to increased length of the triangular cartilage of the septum, which so lowers the columella as to make the upper lip appear hideously short; or the wings of the nose may also be correspondingly increased in length. Displacement of the triangular or lateral cartilages may likewise twist the tip far from the middle line of the face.

Very many of these patients are at the same time greatly hampered by defective nasal breathing, due either to septal deflection or to a narrowed vestibule in consequence of collapsed alæ, as seen in the long, narrow nose with drooping tip. In the former cases I perform a *modified submucous resection* several weeks prior to the plastic operation; while in the latter, reduction of the length of nose, along with a proper elevation of the tip, supplies the needed breathing space. Too great stress cannot be laid upon the necessity of providing always sufficient breathing space. The rhinologist is, therefore, far better qualified to do this class of work than is the general surgeon.

The method of performing a submucous resection when required is of such importance as to merit special consideration; hence the employment of the term above, *modified* resection. If the greater part of the triangular cartilage is exsected, as is done by most operators, the proper support will be found wanting when we come to elevating the tip and shortening the nose. For this reason it is my custom, after undermining the membrane of both sides, to sever the connection of the cartilage from the intermaxillary ridge and from the vomer and perpendicular plate of the ethmoid, leaving the attachment to the nasal bones and the intercartilaginous ridge intact. Then by removing enough of the bony septum in the rear and the intermaxillary ridge below, sufficient space is acquired to permit straightening of the bowed cartilage. The deflection, it seems to me, depends upon lack of space allowed the cartilage by too great an encroachment of the bony septum to which it is attached, much in the same manner as if an attempt were made to place a 16-inch print into a 12-inch frame. Where a thickening exists due to localized ecchondrosis, in order to straighten the cartilaginous septum, excision of a limited portion may be necessary, but the quantity taken need never be so great as to endanger the support for the work to follow. In some instances it may also be found necessary to make a number of incisions through the bent cartilage, in order so

[2] Correction of external nasal deformities by subcutaneous method. Maryland M. J., 1914, Sept., p. 3.
[3] Corrective rhinoplasty. Laryngoscope, St. Louis, 1914, June, p. 1.
[4] External nasal deformities. J. Am. M. Ass., 1916, Dec.
[5] Bone and cartilage grafting in the correction of external deformities of the nose. South. M. J., 1919, March.

[1] Read before the Southern Section of the American Laryngological, Rhinological, and Otological Society, New Orleans, Louisiana, May 27, 1920.

Fig. 1. Case 1, profile.

Fig. 2. Case 1, front view.

to reduce its resiliency as to obtain a straight septum (in the way a decorator makes his molding flexible to conform with an irregular wall).

This method, first employed as a preliminary to plastic operations, has proven so eminently satisfactory that it has been adopted by me routinely in all submucous work.

Having experienced no infection during the past 4 years, it has been found unnecessary to alter the technique of preparing the field for operation, described in previous monographs. A former existing feeling, however, that some of these cases might with advantage be operated upon under local anæsthesia, has given way to the firm belief that ether anæsthesia is always to be preferred.

In order to make clear each step of the procedure, we will take a typical case for consideration, discussing it in detail; then follow with photographs of and brief remarks regarding other cases operated upon.

CASE 1. Miss A. L., age 40. Complaint, difficult nasal breathing and dripping of much mucus from posterior nares into throat. Since earliest childhood she has been subjected to ridicule on account of the unusual size and shape of her nose. At age of 12 she suffered a severe infection, following an attempt which she made to raise and change direction of the tip by introducing hairpins into each of her nostrils.

The nasal obstruction, due to marked septal deflection, was corrected by a modified submucous resection, 3 weeks prior to plastic operation.

The external deformity, you will observe, consisted in a grossly oversized and deformed nose, affecting bony as well as cartilaginous portion. A hump of considerable size, inclined toward the left, surmounted the bony dorsum, where also existed several ridges and irregularities. The tip was very broad and drooped considerably below the lower edges of the alæ. Flaring alæ, large nostrils, and a decided depression where the bony and cartilaginous nose joined on the right side of the middle line complete the description of one of the largest and worst formed noses I had yet endeavored to correct.

It was decided to attempt the entire correction in one operation, under ether, of course.

1. Preliminary incisions for undermining. Through incisions within the vestibule, one on either side, just below and parallel with the attachment of the upper lateral cartilages to the edges of the pyriform opening, the entire skin over the bony nose was undermined. These incisions were joined over the dorsum and extended laterally down to the very root of the nose, thus severing completely the bony and cartilaginous attachments.

2. Smoothing of dorsum. All ridges and irregularities, except the hump proper, were made smooth by means of a coarse rasp.

3. Removal of hump and reduction of height of nose. With saw, introduced first on one side

Fig. 3. Case 2, profile.

Fig. 4. Case 2, front view.

Fig. 5. Case 3.

Fig. 6. Case 3.

and then on the other, the nasal bones were severed at their attachment to the nasal processes of the superior maxillæ and from the bony septum. Then by infracting their attachment to the frontal bone above, the entire bony nose was fully mobilized, thus permitting the prominent lower ends of the nasal bones (the real cause of the hump) to be depressed in such manner as completely to eradicate the humped appearance.

To lower the plane of the dorsum still further a considerable portion of the upper edges of both nasal processes was removed with the coarse rasp, so enabling the nasal bones to drop below their original level. The advantage of this method over the one commonly employed — that of sawing off and taking away the existing hump is quite obvious. I have observed that where this latter procedure has been employed, the dorsum of the nose appears broader and flatter, having lost the smooth rotund outline of the normal nose.

4. Shortening the nose and elevating the tip. A V-shaped section of the entire thickness of the septum, which included the lower edge of the triangular cartilage and part of the subseptum, directly below, was removed. The base of this section was placed beneath the dorsum just above the tip, and the apex at the anterior nasal spine. The removal of this section is best accomplished by transfixing the septum with a straight-pointed, double-edged knife, making two diverging incisions from the anterior spine, and then connecting these two incisions by one parallel with the bridge of nose.

The extent of the elevation of the tip is in direct proportion to the width of this section at its base. Hence, a careful estimation, by accurate measurement, must be made beforehand, in order to obtain the required position of the tip. The gap thus made in the septum was closed with sutures of black silk,—two deep mattress sutures extending through the triangular cartilage, close to the dorsum above and through the columna below, one being tied on each side of the columnella. Three or four mucocutaneous sutures on each side closed the wound edges completely.

Similar but smaller V-shaped sections were removed from the upper lateral cartilages, one on each side, the bases of these meeting at the middle line of the nose. The initial incisions, at

Fig. 7. Case 4.

Fig. 8. Case 5.

Fig. 9. Case 6.

Fig. 10. Case 6.

the junction of the upper lateral cartilages with the pyriform opening, were utilized as the upper arms of these sections, making but one additional incision necessary on each side for this purpose. Sutures in this situation have not been found necessary, the wound edges being held together with adhesive dressing, the type of which will be described later.

5. Reduction of width of cartilaginous nose and tip. With a double-edged, pointed knife, curved on the flat, punctured incisions were made through the cartilages and the lining membrane, from within, one on each side of and parallel with the septum. The point of the knife was introduced 3 millimeters from the lower edge of the alæ and pushed upward, undermining the skin in its passage, and continuing until the point of the knife met with no resistance; in other words, until the undermined area thus made joined with the sections previously removed from the upper lateral cartilages. This undermined area was further slightly increased laterally to accommodate one blade of the punch-forceps, the other blade being introduced into the nostril. With these forceps so placed, a strip of the cartilage with its lining, 5 millimeters wide, was removed, thus reducing the width of the nose, including the tip, 1 centimeter. Here also we rely upon our adhesive dressing to hold the wound edges together.

6. Final dressing of the nose. The vestibule was then packed lightly with iodoform tape (nu-gauze, one-half inch), and adhesive strips (shown in Fig. 5, at left) were so applied as to compress the tip and support the entire cartilaginous nose. This type of dressing also serves to bring together all the wound edges in the cartilaginous nose wherein sutures were not employed, and usually remains 4 or 5 days. After this time the type of dressing shown in Figure 5, at right, is substituted as a safeguard against sagging of the tip, and is utilized for about 4 weeks, changing it every 4 or 5 days. Of course, over these adhesive dressings the usual saddle splint is applied.

In all these cases one must carefully outline the plan of procedure and estimate by measurement the exact extent of the alteration intended. The task in Case 1 was to lower the dorsal plane at least three-eighths inch, smooth all irregularities and remove the hump; to elevate the tip and reduce its width 1 centimeter. Finally, the entire nose was to be shortened at least one-half inch. Accurate measurements were obtained by making the copper saddle splint one-half inch shorter than the nose, and the depth of the splint three-eighths inch less than the height of the bridge; then to reduce the nose to conform with size of the splint. The punch-forceps, which remove strips of cartilage 5 millimeters in width, serve as a measure for the necessary narrowing of the tip.

Case 2, Mr. M., and Case 3, Mr. B., a discharged soldier, were done in exactly the same manner as was Case 1, one operation being required for submucous resection and one for plastic correction.

Case 4. Miss B. required no submucous resection, the entire result having been obtained in one operation.

Case 5. Mr. J., in addition to the oversize, had a marked lateral displacement and a more pronounced

Fig. 11. Case 7.

hump, following fracture in foot-ball game. A preliminary submucous resection was done, followed by two plastic operations: the first to restore form and position to the nose, the second to reduce and elevate the tip. This case illustrates the evil resulting from failure to set properly the fractured nose immediately following injury.

CASE 6. Miss K. K. Presented a hump nose with a very deep notch above, and a flattened and depressed tip, making the upper lip very short. First, a submucous resection to restore nasal breathing; second, after removing hump with saw, a graft taken from the seventh rib, consisting of two-thirds bone and one-third costal cartilage, was inserted through incision made within the left vestibule. This graft extended from the nasal notch above to the tip below, and furnished a perfectly straight profile. The extreme tip of the nose, however, sagged below the end of the graft and appeared flattened as well. For this reason a second plastic procedure was needed. The tip was brought up and made fast by two mattress sutures to the lower cartilaginous end of the rib graft.

CASE 7. Dr. I. This case of saddle nose is shown for the purpose of illustrating the importance in submucous work, of always leaving as much triangular cartilage as possible for support of the nose. Patient came into my hands about a year after having had a submucous resection performed in a neighboring city. The result here shown was obtained in one operation, by the insertion of a graft from the seventh rib. All dressings and splint were discontinued in 10 days, and the patient returned to his home in North Carolina 2 weeks after operation.

FOREIGN BODY IN THE ŒSOPHAGUS

BY A. L. BLESH, M.D., F.A.C.S., OKLAHOMA CITY, OKLAHOMA

A FEMALE child, age 3 years and 6 months, was brought to the hospital with the following history:

Since birth the child has had difficulty in swallowing, especially solids. While at play 24 hours before, she swallowed a $\frac{5}{8}$ inch steel ball-bearing, since which time she has been unable to swallow anything, even water regurgitating. A roentgenogram (Fig. 1) shows the foreign body lodged in the lower third of the œsophagus.

The following technique was used in removing the foreign body: The distal rounded end of a stomach tube was cut and the funnel removed. The funnel end of the tube, which flared somewhat, was passed down to the foreign body. To the cut tip of the tube was attached an ordinary piston from a 150 cubic centimeter bladder syringe. Strong suction was applied and the tube was slowly withdrawn. The ball would cling to the tube until it reached the pharyngeal muscles when it would be dislodged by muscle spasm. This happened several times when it was decided to anæsthetize the patient. The ball was then withdrawn at the first attempt

This case is reported for the following reasons:

1. To describe the simple, yet novel and effective method of removing a foreign body from the œsophagus.

2. To record a case having an anomalous and relatively rare condition of congenital stricture of the œsophagus.

Fig. 1. Roentgenogram showing foreign body lodged in lower third of œsophagus.

REMOVAL OF MISSILE FROM THE RIGHT VENTRICLE OF THE HEART WITH RECOVERY

By W. H. LUCKETT, M.D., F.A.C.S., New York City

THIS case is reported simply as a matter of record and in further illustration of the fact that the heart is by no manner of means the delicate organ it was formerly presumed to be.

H. C., age 19, was admitted to the Harlem Hospital, July 20, 1919, with the following history:

The father died from unknown cause, the mother is alive. The patient had measles in childhood and dermatitis venenata 4 months ago.

The patient's husband shot her just before admission; vomited blood. Physical examination shows a young adult female, black, well-nourished, and acutely ill. The head is normal in size, shape, and contour. The eyes, ears, and nose are normal. The mouth and neck are negative. The chest is symmetrical and well developed; there is a penetrating wound in first intercostal space of the left side, about three-fourths of an inch from the sternum. Around the wound is a fairly large area of subcutaneous emphysema, and a superficial seton wound 2 inches long in the left lumbar region, posteriorly. Examination of the lungs shows decreased breath sounds on the left side. No pneumothorax is apparent as yet. The breathing is more labored than normal and painful. Examination of the heart was *negative*.

The pulse was fairly rapid but of good quality. The abdomen was negative, extremities negative, reflexes normal.

With oxygen injection in the abdomen, an X-ray picture was taken by Dr. W. H. Stewart who reported a missile in the heart. This was verified by fluoroscopy which showed the missile pulsating with the heart. (Fig. 1.)

Operation, July 28, 1919, with nitrous oxide and ether by inhalation anæsthesia, ether by open mask. A 5-inch (Fig. 2) sixth intercostal space thoracotomy was done, and the wound held open by a Tuffier rib spreader. The pleural cavity was totally free from blood; the missile was faintly palpated in right side of the heart near the apex. An incision 3 inches long was made in pericardium on the left side and was held open by linen traction sutures. The pericardial cavity was absolutely free from blood. The heart was delivered through the pericardial incision and rotated forward from right to left and upward. The heart was firmly grasped by two Allis clamps, one on either side of the missile, about 1 inch apart. An incision three-fourth of an inch long and about one-fourth inch deep was made through the wall of the right ventricle down to the apex of the missile which was grasped by an artery clamp and extracted (Fig. 3). The incision into the heart bled only scantily until the missile was extracted when it was

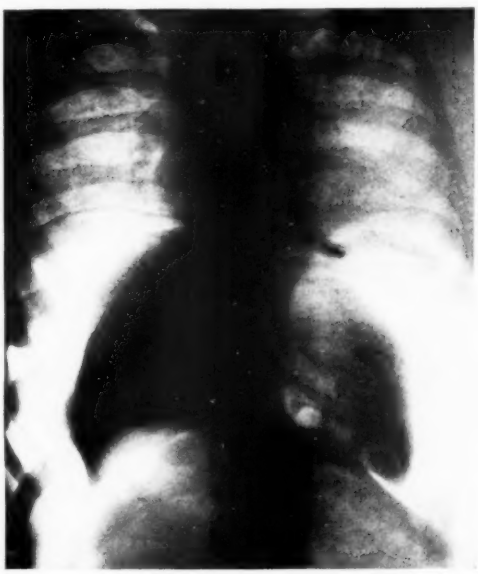


Fig. 1. Thirty-two caliber revolver bullet in heart. Note duplication of bullet shadow which is due to cardiac pulsations. Distinct outlines of abdominal organs and diaphragm due to oxygen injection into abdominal cavity.

Fig. 2. Untouched photo of patient. Note cicatrix.

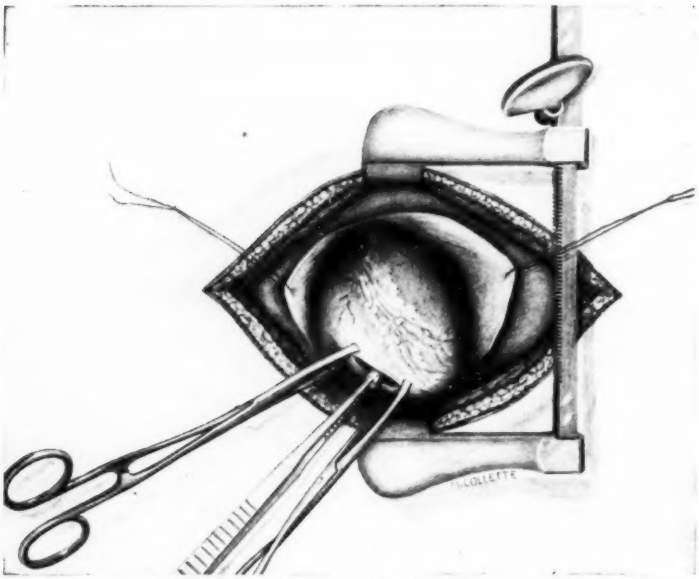


Fig. 3. Intercostal wound held open by Tuffier rib spreader. Pericardial wound held open by linen traction sutures.

followed by a profuse hæmorrhage, spurting with each cardiac impulse. Three deep catgut sutures were placed in the heart to close the wound, and Allis clamps were removed when the upper angle of the wound bled freely. This was controlled by a fourth suture in the heart. The pericardial cavity was sponged of all blood. The pericardium was closed by catgut sutures, a small opening being left at the lower angle of wound for drainage into pleural cavity. Thoracotomy wound closed without drainage.

The patient left the operating table in most excellent condition and remained so until the fourteenth day when she was allowed out of bed. That night the patient contracted "a cold" and the next day had a severe bronchitis. At night she had an œdema of the lungs which came near causing her demise. After this for 2 weeks she had rather a stormy convalescence.

On August 5, the heart was markedly displaced to the right; area of cardiac dullness normal in limits. The heart was regular and rapid. The rate of the heart and radial pulse were equal. Pericardial friction rales were heard.

On August 20, the heart was displaced to the right, the right border being displaced about 2.5 inches to the right of the sternum. It was regular in rate and rhythm but rapid. Lungs-breath sounds were heard anteriorly over the apex to the second interspace, posteriorly along the spine to the base; moist râles were present in the interscapular region. High up in the left axilla breathing was heard, but very faintly. Tactile fremitus was absent over mid and lower lobe. X-ray showed a collapsed lung with pneumothorax and fluid in the left pleural cavity.

The upper bullet wound had been discharging pus since before the operation. The posterior angle of the intercostal wound was opened and the pleural cavity drained. The fluid culture showed staphylococcus. The pleural cavity was washed out with Dakin's solution for 2 weeks, when the drain was removed and the wound allowed to close.

An X-ray picture in September showed the lung fully expanded and the patient was then discharged.

The curious part to one not familiar with the bizzare movements of missiles after they strike the human body, is how the missile got into the heart. The patient was standing in the erect position and was shot from directly in front with the assailant also in the standing position. The seton wound in the left side is horizontal to the vertical axis and the wound in the first intercostal space seems to have been made by the missile striking the skin at a right angle. There was no blood in the pleural cavity and what is more there was no blood in the pericardial cavity, neither could I find the wound of entrance of the missile into the heart. The facts that the missile lay in such a position to the wall of the heart, that the depth of the missile one-fourth of an inch from the surface, the length of the missile (32 caliber), one-half inch long, together with the profuse hæmorrhage after extraction, lead one to believe that the base of the bullet actually jutted into the cavity of the ventricle.

No particular conceit should be delegated by the operator to himself for the successful outcome of such a case. If a case of heart wound is not killed outright, it should withstand operation by any experienced surgeon in thoracic surgery bold enough to make the attempt.

THE JOHN B. MURPHY MEMORIAL

THE September number of SURGERY, GYNECOLOGY AND OBSTETRICS contained an editorial upon the proposed memorial to the late Dr. John B. Murphy. This memorial, which in form is to be a hall and a pantheon for and to American surgery, will be given to the American College of Surgeons and will be maintained by them in perpetuity.

The building in which this memorial will be housed will be open to the surgeons of the United States, Canada, and other countries of North and South America. Together with the administrative offices of the American College of Surgeons, it will represent in America what the Royal College of Surgeons, with its John Hunter Museum and Library, does in England—a central meeting place and mecca for the surgical profession of the world. In addition to the great memorial hall for the accommodation of large scientific meetings of national and international scope, this home of surgery will contain meeting rooms for smaller surgical societies. It will maintain for all of the profession a department of literary research, a library and reading rooms, and eventually a comprehensive working surgical museum.

The plan of the John B. Murphy Memorial Association to make the American College of Surgeons the recipient of its generous gift very properly links the name of Murphy for all time with a responsible organization which has for its object the maintenance and advancement of the science, the art, and the ideals of the surgical profession of the Western Hemisphere — an organization which welcomes to its Fellowship every worthy and competent surgeon and surgical specialist.

Few readers of SURGERY, GYNECOLOGY AND OBSTETRICS can fail to be interested in honoring in a dignified and useful manner this master surgeon of our generation.

POPULAR SUBSCRIPTION

The cost of the proposed building is estimated at $500,000. Of this amount, $100,000 have been pledged by one of those most interested. The balance to be raised, $400,000, has been allotted by the Board, $200,000 to lay friends, and $200,000 to professional friends and associates of Dr. Murphy. To raise this amount from the profession will necessitate a number of $5,000 subscriptions, a larger number of $1,000 pledges, and probably one thousand $100 gifts.

While a substantial number of large subscriptions are anticipated in the near future, the Association at this time wishes to open its books to a popular subscription, the unit of which will be $100. This is an amount that is within the reach of all of the lay and professional friends of this great surgeon, whose memory is so worthy of honor.

The form of pledge that is being made is reproduced on advertising page 8 of this issue. It will be noted that no immediate payment is called for, and the amount promised may be paid in installments.

Of the 140,000 physicians of the United States, 25,000 of whom are surgeons, and all of whom have profited and have been inspired by this great teacher, are there not fifteen hundred who will contribute some multiple of $100 to this memorial?

The Executive Board wishes to express its appreciation of the liberal responses already received from the members of the profession.

Subscriptions may be sent to the President of the Board, Mr. Edward N. Hurley, Room 1314, 30 North Michigan Avenue, Chicago.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

SURGICAL shock, its causes, and prevention as well as its treatment has been the cause for much speculation and study. Probably no investigator either here or abroad has given this treacherous condition more serious consideration or study than Crile. Although his theories are disputed by some, it seems to the reviewer that a careful consideration and study of his recent rendition will convince many of the doubtful. Irrespective of the view accepted in regard to shock, the technique and theory of anoci-association, must be received with open arms. Brutal operating should cease.

In a preface the author states that the purpose of this monograph[1] is to present concisely "the principles upon which the doctrine of anoci-association is based and their practical application." The various theories of shock are omitted. Much evidence and data were obtained by practical observation during the recent war and as the author states in the chapter on shock and exhausted, anoci-association and restoration in military surgery: "Our researches on animals which have extended through many years, have included experiments covering every cause of shock and exhaustion except those which are impracticable on account of their cruelty. This war, however, has provided ample human material to make good the deficiencies in laboratory researches caused by due consideration for the suffering of animals."

The author again gives a comprehensive review of the research on shock, presenting it in a very convincing and attractive way, all points being verified by ample check.

The principles of anoci-association as associated with shock and operative procedure are described in detail. The text is in the usual beautiful style which characterizes the writings and work of this brilliant surgeon. No surgeon may call himself proficient unless he observes, if not entirely, at least to a marked degree, the axioms laid down by the author.

J.A.W.

ALTHOUGH the treatment of syphilis in a general way may be clearly understood by the profession, yet the many details such as the chemistry of arsphenamine, definite technique for the administration including dosage in children, and plan of attack in different types of the disease are vague to many. The recent monograph by Baketel[2] surely fulfills a long wanted necessity. The text is brief yet covers the subject completely. The chapters on the history and chemistry of arsphenamine, the chemotherapy of arsenic compounds, and the treatment of syphilis of the central nervous system, deserve especial mention. The mixed treatment is discussed and plans for mercury treatment given in detail. The text is well illustrated and the book deserves a place in the library of not only the surgeon but of any of the profession who are called upon to treat or observe the treatment of this plague of mankind. J.A.W.

THE past four years has shown a marked increase in our economic exchanges with the world at large. Today there is scarcely a port or nation where the American soldier or sailor may not be seen. Mandates are being urged upon us. If the medical profession is to keep step with our economic and political advance, it behooves us to become familiar, at least to a certain extent, with the diseases peculiar to distant climes. Certain surgical conditions may be found the world over, yet one is interested to know that appendicitis is comparatively rare in Egypt. In one hospital only 22 cases came to operation in a series of 1716 surgical cases in the year.

In a monograph by Madden[3] the surgery peculiar to Egypt is presented in a very brief and unique way. The author gives the experience of 20 years of surgical work in Egypt, endeavoring to describe the essentially Egyptian conditions in detail, and points out wherein Egyptian surgery differs from the present day English surgical practice. Especial attention is given to those pathological conditions which are prevalent, such as bilharzial infection, syphilis, madura foot, various parasitic diseases, elephantiasis, splenomegaly, and rhinoscleroma. The text is well illustrated and of decided interest to the surgeon who wishes to familiarize himself more or less with oriental surgery. J.A.W.

[1] SURGICAL SHOCK AND THE SHOCKLESS OPERATION THROUGH ANOCI-ASSOCIATION. By George W. Crile, M.D., and William E. Lower, M.D. 2d ed. thoroughly revised and rewritten. Philadelphia and London: W. B. Saunders Company, 1920.

[2] THE TREATMENT OF SYPHILIS. By H. Sheridan Baketel, A.M., M.D. New York: The Macmillan Company, 1920.

[3] THE SURGERY OF EGYPT. By Frank Cole MacHen, O.B.E., M.D. (Melb), F.R.C.S. (Eng.). Cairo: The Nile Mission, 1919.

AMERICAN COLLEGE OF SURGEONS

NEW CONSTITUTION AND BY-LAWS OF BRIDGEPORT HOSPITAL OF WIDE INTEREST

THE program of hospital standardization, as it proves itself to be of constructive value among hospitals, is now being reflected in new constitutions and by-laws of hospitals. Such progress is purely at the initiative of the hospitals, but it indicates the depth to which the minimum standard of the College has penetrated. It means really a service in hospitals which shall command more confidence and good will on the part of the public for hospitals than has ever been true before in history.

The Bridgeport Hospital at Bridgeport, Connecticut, has recently adopted a new staff organization, constitution, and by-laws. The following articles from this reorganization will be of interest to every one who has to do with hospitals.

ARTICLE II

Membership. Membership upon the staff shall be restricted to physicians and surgeons who are competent in their respective fields and are worthy in character and in matters of professional ethics. The staff shall be governed by the code of ethics of the American Medical Association. No physician or surgeon who divides fees under any guise whatever, according to the standard of the American College of Surgeons, shall be eligible for the Staff in any capacity.

ARTICLE IV

Objects. The objects of this general staff organization are:

1. The improvement of hospital practice by definite placing of responsibility for prompt and proper decision upon all questions which may arise.

2. The promotion of co-operative and group study of cases.

3. The holding of regular meetings for the study and discussion of medical, surgical, and scientific questions relative to hospital work, and the presentation of papers thereon.

4. The general discussion of matters affecting staff or hospital welfare by the entire staff, furnishing a basis of knowledge, opinion, and advice upon which the directing staff and the efficiency committee may draw if they so desire.

5. The restriction of all privileges regarding admission of, operating upon, and care of, patients in any part of the hospital to those physicians and surgeons responsible to the hospital, who are appointed to the general staff by the board of directors upon recommendation by the efficiency committee.

Exception 1. *Consultants.* Any physician or surgeon may be invited by any member of the general staff to operate upon or care for any patient, provided that member requests in writing and receives permission therefor from the medical superintendent of the hospital and from the chairman of the efficiency committee, and provided further that such member agrees to be responsible for all the work of the man invited, as for his own.

Exception 2. *Emergencies.* In exceptional cases, the medical superintendent of the hospital may extend to a member of the staff of any other hospital upon his written request with reasons therefor, the corresponding privilege of his own hospital. In such a case the medical superintendent of the hospital shall assume the responsibility to the hospital for the patient, and shall transmit the request to the efficiency committee for approval later.

Exception 3. *Permits.* The medical superintendent may permit a limited number of physicians and surgeons (not to exceed 30), not members of the staff, to care for patients in private rooms and semi-private wards only, under the following conditions:

The physician shall apply for such a permit to the medical superintendent upon a suitable form:

1. Specifying not more than three departments under which he wishes to work, viz., major and minor surgery, minor surgery, medicine, neurology, ophthalmology, otology, rhinology and laryngology, oral surgery, major and minor obstetrics, minor obstetrics, pediatrics, dermatology;

2. Declaring himself competent to work in these departments;

3. Subscribing to Article II as to eligibility;

4. Declaring himself subject to the direction of the heads of departments under which he works, and responsible to the hospital for all patients under his care;

5. Agreeing to be subject to the same rules as staff members, including attendance at general staff meetings; and

6. Agreeing to send to the hospital not less than three private patients every six months. Such application for permit, when signed by the applicant, shall be placed at the foot of the waiting list.

When a vacancy in the permit list occurs, the medical superintendent will present the first application on the waiting list to the efficiency committee who will, after consultation with the directing staff, transmit it with recommendation for approval or disapproval in whole or in part to the executive committee of the directors. If approved by the latter, the medical superintendent shall issue to the applicant written permission to care for private patients in the departments approved, which will be valid until revoked, and shall post his name, with the departments in which he is permitted to work, at the bottom of the permit list in the staff room.

This permission may be revoked by the executive committee of the directors upon recommendation of the efficiency committee at any regular meeting. In such a case the medical superintendent shall immediately send to the permit holder written notice that his permit is revoked, shall erase hi s name from the permit list, and shall present the next application to the efficiency committee.

No physician whose permit is revoked shall apply again within one year for any privileges of the hospital.

The efficiency committee should apportion the permits among the different departments so that minor surgery, medicine, minor obstetrics and pediatrics may have nine to eighteen each, the other eight departments three to six each. The total number of permit holders shall be thirty, until such time as the executive committee of the directors upon recommendation of the efficiency committee shall reduce this number by revoking a sufficient number of the permits last issued.

Exception 4. *Ex-interne permits.* Physicians who have satisfactorily completed a term of interneship in any reputable hospital, and who have practiced in Bridgeport, less than five years, may apply for and be granted permits to care for patients in private rooms and semi-private wards only, under the same conditions as in *Exception* 3, except as follows:

1. The number of departments under which permission to work is applied for is not limited, and no specified number of private patients is required to be sent to the hospital.

2. All private work done in the hospital must be under the direction and responsibility of some member or members of the consulting or directing staffs approved by the efficiency committee, who have previously obtained from such staff member his consent to undertake such direction and responsibility for work in his department, valid until withdrawn in writing.

3. Such permits shall be marked "Ex-Interne Permit" and may be issued without limit as to number, at the discretion of the efficiency committee.

4. Holders of ex-interne permits may be called upon by the efficiency committee to do interne or other hospital work for short periods in emergencies; or if need arises may be regularly assigned by the efficiency committee to assist any members of the directing staff in general service or other work for the benefit of the hospital.

New members of the regular assistant staff shall ordinarily be appointed from the ex-interne permit list.

No physician or surgeon shall be granted any privileges under this section, who is unable to qualify under Article II.

ARTICLE X.

The Efficiency Committee. Duties. 1. The efficiency, or representative executive committee of the directing staff, shall meet with the executive committee of the directors of the hospital semi-monthly, shall work with and advise them upon all matters touching the staff, and shall present to them monthly a written report. All official communications from the directing staff as well as from the general staff, to the executive committee or board of directors of the hospital, shall be presented through the efficiency committee.

2. The efficiency committee shall in November of each year recommend to the executive committee of the directors such changes in the staff for the ensuing year as they think wise. The staff will be appointed by the directors at their annual meeting to serve one year from the first of the following month or until their successors are appointed.

3. The efficiency committee shall be responsible for the procuring, fitness and discipline of the interne staff, but should delegate this work entirely to the medical superintendent of the hospital, except appeals from the decision of the latter.

4. The efficiency committee shall consult and advise with the directing staff, and shall keep the directing staff fully informed of their activities by a written monthly report, to be amplified verbally upon request. Matters upon which in their opinion discussion would be untimely may be withheld from the monthly report, if reported in full within three months.

5. The efficiency committee shall post lists of those staff members and permit holders who may use the operating room for major operations, and for minor operations, and of those who may use the delivery room for major and minor work and shall see that these rooms are only so used, except as provided in Article IV, Section 5, Exceptions 1 and 2.

6. The director of records with the aid of the assistant staff shall cause an adequate typewritten abstract of the history of every patient in the hospital to be made immediately upon the patient's discharge, upon such a form as will show all essential facts, including group diagnosis, consultations, treatment and final result. The efficiency committee shall see that every history with abstract attached is carefully examined by one of its members, and either marked "passed" and initialed by the member examining it, or marked "defective" and not initialed. The efficiency committee may refer any "defective" chart, either with or without the name of the patient or the doctor responsible for that patient, to the directing staff at its next meeting for discussion and information. If, in the final opinion of the efficiency committee, any chart does not show proper working up of the case or proper treatment, it must be referred to the next meeting of the general staff and the physician or surgeon responsible for that patient called upon to explain or defend his position. All questions arising under this section shall be decided upon the basis of whether the patient, *as shown by the chart*, has received from the hospital in the way of diagnosis and treatment, what he is entitled to receive from a modern hospital.

7. The efficiency committee shall see that every member of the directing staff submits to the medical superintendent a typewritten statement of what he expects from his interne. These statements shall be passed upon by the efficiency committee and issued by the medical superintendent to the internes, who will be held responsible for the duties outlined in these statements. This should be done with each change of service until a satisfactory standard is obtained. These statements are to be considered as minimum requirements, and in no way as limiting an interne's initiative. Internes should submit any suggestions for improvement in writing to the medical superintendent who will refer them to the efficiency committee.

No order or complaint by any member of the staff or permit holder will be considered unless put in writing and signed, but will be held confidential if so marked. Questions or complaints of any kind arising from the relations between staff, internes, nurses, and patients must be submitted in writing to the medical superintendent who will take proper action. From his decision any party in interest may appeal to the efficiency committee, whose decision subject to approval by the executive committee of the directors, shall be final. The medical superintendent shall submit a monthly report to the efficiency committee, embodying all complaints received during the month, and the action taken.

8. The efficiency committee shall appoint a standardization committee for each department of the hospital, shall outline its duty and scope, and shall be responsible for the completion of its work and the standards adopted. The medical superintendent shall be *ex-officio* member of all standardization committees.

9. The efficiency committee shall appoint a committee to arrange for teaching clinics for the internes, not less than two hours per week, at which all internes must be present unless excused by the medical superintendent. These clinics shall be given by all members of the directing staff in turn, using such material as their service affords, and by such members of the consulting staff as may volunteer for this purpose. These clinics shall be open to outside physicians and nurses at the discretion of the efficiency committee. Such clinics shall be listed in advance, and so far as possible the clinics arranged in systematic courses.

10. The efficiency committee shall appoint a training school committee consisting of the superintendent of nurses, the medical superintendent of the hospital, two members of the directing staff and one of the consulting staff, and shall arrange for a study of all questions connected with the department of nursing. All communications from this committee to executive committee of directors shall be made through efficiency committee.

11. Requisition for instruments and medical and surgical supplies from any department shall be passed upon by the efficiency committee, or by a committee appointed by them, and will be provided only upon their approval.

12. The efficiency committee shall appoint such special committees as may be needed to aid or advance their work; shall outline their duties and scope and be responsible for the completion of their work.

13. The efficiency committee shall cause a record to be kept of all physicians holding permits and members of the general staff, except the retired staff, showing attendance and time spent at the hospital, completeness of records, attendance and work done at staff meetings, including papers read or published elsewhere, number of private patients sent to the hospital, and amount of teaching in clinics for internes.

14. The efficiency committee shall encourage:

a. Every member of the directing staff to publish a paper each year for which credit is given to the hospital.

b. Every member of the assistant staff to prepare such a paper each year for the general staff meetings, which the efficiency committee will publish at their discretion, if not otherwise published.

c. Every member of the consulting staff either to publish or prepare such a paper every second year.

The standard of papers required shall be that of the American Medical Association.

STANDARDIZATION THE "KEYNOTE"

IN his presidential address recently read before the Catholic Hospital Association at St. Paul, Charles B. Moulinier, S. J., stated the "keynote" of the new magazine of the association, called *Hospital Progress* as follows:

"Hence, I felt moderate in claiming that, with the advent of our new magazine, the spirit and special note of this convention may most properly be designed as *hospital progress* in standardization. Due to the enlightened, energetic, and determined efforts put into this drive for better hospitals in the United States and Canada by Doctor Bowman for and with the American College, and by all the other co-operative organizations, there is no thinking, informed, and unbiased person in the United States and Canada today who does not accept without questioning the conclusion, that a hospital to be efficient in the giving of up-to-date service to the sick must be organized, must have records that are complete, and must furnish the facilities for adequate laboratory service; and this for all the patients of the hospital.

"I am sorry, however, to say that there are some few unthinking, uninformed, or biased people in the United States and Canada still, who have not yet seen the light nor felt the warmth of this "sun of justice" to the sick, or who are, as yet, influenced by motives which will not bear close scrutiny in broad daylight.

"This effort to secure better hospitals, let me say in passing, is not a high-brow, autocratic, busy-body attempt to pry into other people's business, to curtail individual or personal rights, to assume any authority whatever over institutions, organizations or associations. It is not a usurper in any sense of the word, but it is the logical, inevitable, and irresistible march of an idea and, if you will, an ideal, namely, the securing to the patient, just because he is a human being, the right he has, the God-given right he has, to expect full and high-grade care in view of what modern medical knowledge and skill are. The right of a human being to the best current medical care is the sunlight of truth that is illumining the world. That this care cannot be given with sureness and consistency except in an organized, fully equipped and carefully recorded service, is the discovery of these recent days, made by the leading minds of the medical profession and now being carried out with unexampled vigor, tact, and sympathy by Doctor Bowman, seconded and assisted by all the rest of us. I do not make this statement with a view to praise, much less to flatter, but just to have the plain facts before us. Who seriously cares where the credit goes, provided we all get the best of medical care when we are sick? So then our special theme at this convention is *progress in hospital standardization.*"

ANCON HOSPITAL, ANCON, CANAL ZONE

By COLONEL F. H. HESS, Medical Corps, U.S.A.
Superintendent, Ancon Hospital

ANCON Hospital is one of the old landmarks at the Pacific entrance of the Canal Zone, having come into existence in 1883. Through its portals there have passed many thousands of patients. Within the confines of this institution hundreds have passed to the "Great Beyond, from whose bourne no traveler returns"; many of them victims of those dreaded maladies, pernicious malarial and yellow fever. It has been intimately connected with the building of the Panama Canal, under both the French and American régime, and is now, as formerly, the hospital to which nearly all the civilian and military patients of the Canal Zone are sent who are in need of hospital treatment; also many persons from the Republic of Panama, Central and South American Republics, seek admission there for treatment, so that its renown is more than local.

Any description of Ancon Hospital would not be complete historically without a description of this institution during the French régime and at the time it was taken over by the Isthmian Canal Commission.

The original Ancon Hospital was established by the old French Company, which erected the first building in 1883, on a reservation of about 150 acres, on the northern and eastern slopes of Ancon Hill, which commands an extensive view of Panama Bay, City, and surrounding mountains. Ancon Hill is 654 feet above sea-level. The grounds on the eastern and northern slopes of Ancon Hill up to the 200-foot contour were laid out, terraced, and graded by the French Company, and upon these terraces were erected the several wards and other buildings of the original Ancon Hospital. The buildings were of frame construction, of the pavilion type, with tile roof, but unscreened.

The hospital was operated under contract by the French Sisters of Charity, in accordance with whose terms people engaged in Canal construction were treated at a rate of five francs per day. The result of this system was that very few negroes were sent to this hospital, and the patients were, therefore, almost entirely white employees.

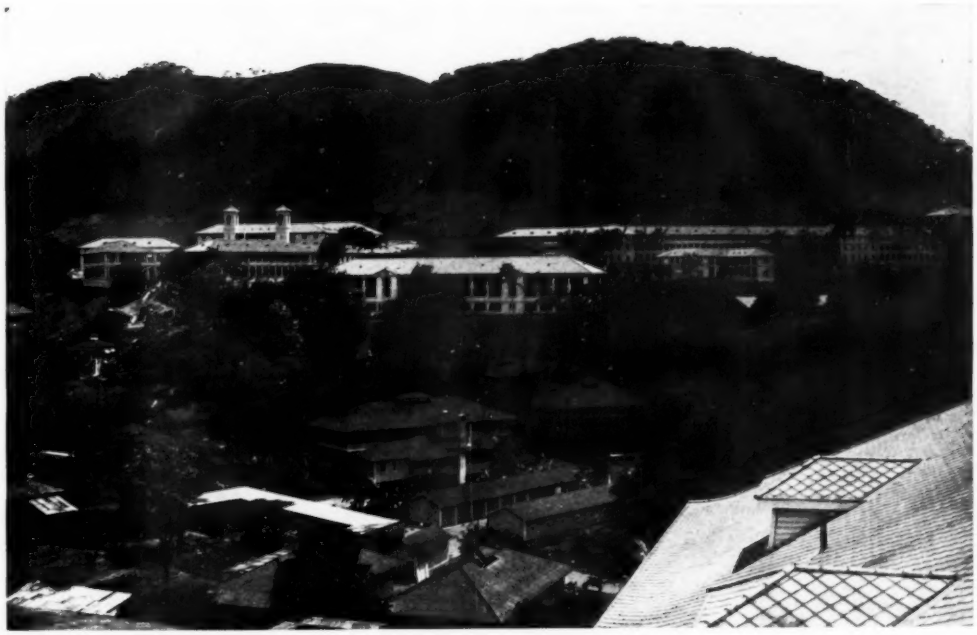
The old French Company failed in 1889, but left a complete set of hospital records which show that from 1883-1889 over 5,000 deaths occurred in the hospital; 1,200 of which were from yellow fever.

The majority of the yellow fever cases contracted the disease while patients in the hospital for the treatment of injuries or other diseases. This was due to the fact that the Sister Superior, who was very fond of flowers, had the grounds around the hospital buildings planted with flowers of every description. In order to protect these flowers from the ants, which were great destroyers, the flower beds were surrounded by concrete, with a depression hollowed out on top to hold water, so that the ants could not get at the plants. These pools of fresh water furnished ideal breeding places for mosquitoes, so that patients admitted to the hospital surrounded by these beautiful flower gardens became victims of the diseases transmitted by mosquitoes; hence the reason for so many deaths from yellow fever among the non-immune patients admitted to yellow fever wards.

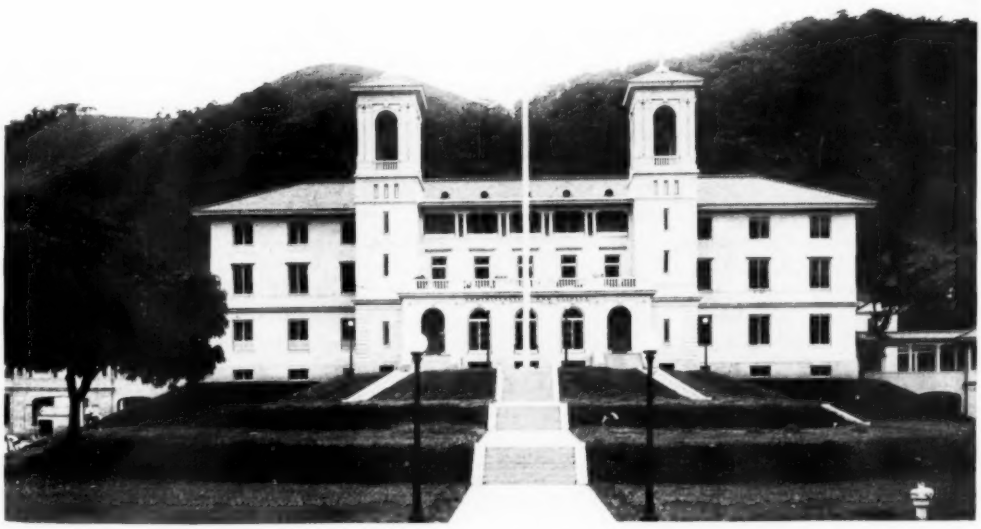
The Americans took charge of Ancon Hospital in May, 1904, at which time the construction of the Canal under American régime began. The work of clearing the grounds and tearing down buildings was at once begun. All wards were screened, some new ones were built, and a second story added to some of the buildings, so that within the hospital reservation there were in all 96 buildings, in 32 of which were 47 wards, with a total capacity of about 1,200 patients. All the wards had modern equipment of U. S. Army standard and were provided with lavatories, closets, showers, and bath tubs. The operating room was spacious and the equipment was entirely modern and complete, as were the eye, ear, nose and throat and X-ray departments, so that old Ancon Hospital although of wooden construction, when completely remodeled and refitted by the Americans, compared very favorably with the hospitals in the United States and afforded every facility for up-to-date treatment of all classes of cases.

The Panama Canal was completed and opened to traffic in August, 1914. Since then the Government has expended many millions in development of terminals and in municipal improvement. Most of the construction is of a permanent character: reinforced concrete or semi-concrete and hollow cement curtained walls; cement stuccoed or lime plaster.

The most beautiful group of buildings from an architectural point of view is the one comprising



General View of the Ancon Hospital.



Administration and Clinic Building.

Main Entrance to New Ancon Hospital.

new Ancon Hospital. This group of buildings supplants the original French wooden hospital buildings and was erected on an irregular and restricted site crowding the base of Ancon Hospital, overlooking the Bay and City of Panama, with a beautiful vista of the mountains in the distance.

The style of architecture is a modified Italian Renaissance. The plan adopted was isolated "sections" or ward units as far as possible, without departing too far from the economy of central administration, and this idea together with the irregularity of the site fixed the height of buildings at from two to four stories.

Shelter from tropical sun and rain is afforded by wide corridors around all exposed sides of the ward units, also direct inter-communication between the sections or ward units by loggias and continuous porches, which connect the various wards with the Administration-Clinics Building and the Kitchen and Mess Building.

The construction is of reinforced concrete, with hollow cement block curtain walls and partitions, cement stuccoed outside. All roofs are covered with vitrified Spanish red tile; inside walls and ceilings of concrete and plaster, generally painted with a washable paint. Porches and outside openings are copper-screened against insects. For the most part, all floors are of six-inch red ceramic or white hexagonal tile, or cement; the latter for the porches. A few of the offices have yellow pine floors.

The general plan of the five ward groups, exclusive of isolation section, is two wards on each floor with auxiliary rooms between; visiting room, ward dining room, ward and diet kitchens, cells, quiet rooms, doctors' and nurses' room, dressing room, ward laboratory, toilets and baths, service room, closets, elevator and stairs.

Isolation section is four stories in height, with a normal bed capacity of 113, and emergency capacity of more than 155. On the different floors are small wards, rooms with separate baths, so arranged that all classes of contagious and infectious disease can be isolated without any danger of their spreading. It is not an unusual occurrence to have at one time eight or ten different varieties of contagious or infectious disease in this section.

Interior Scene of Hospital Grounds between Rear of Administration Building and Kitchen and Mess Building, Showing Style of Architecture and the Beautiful Ground and Tropical Foliage.

Section "B" is the section for private pay cases, obstetrical, gynecological; the medical and surgical ward for white women. There are 40 private rooms, capable of accommodating 45 patients.

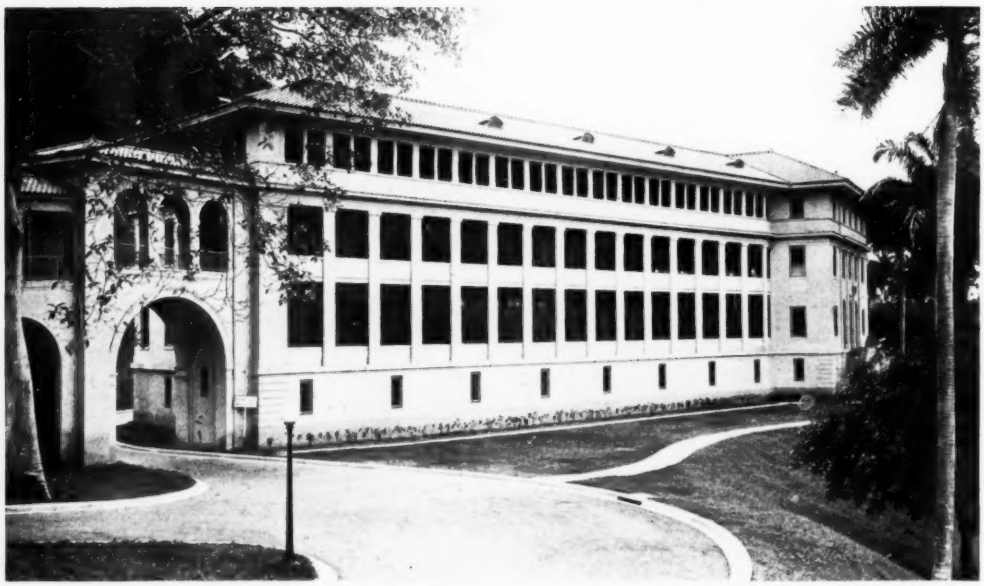
The central building of the hospital group is the Administration-Clinics Building, containing pharmacy and drug manufacturing department, the surgical; medical; eye and ear clinic; the operating pavilion of four operating rooms in suite; X-ray department; administrative offices and record room; library and general assembly rooms; and in the basement it is contemplated to install a hydro-electro-therapeutic department. It is also contemplated in the near future to establish in this building a clinic for the treatment of genito-urinary and skin diseases.

Back of the Administration Building is the Kitchen and Mess Building, where all the cooking and baking for the hospital is done and where also is located a large refrigerating plant. On the upper floors are dining rooms for the convalescent white patients and for the nurses and internes. On the second floor is the dining room for the convalescent colored patients and colored employees of the hospital.

The buildings are all equipped with electric passenger and freight elevators, automatic dumb waiters, fire protection, running hot, cold, and ice water, steam, telephones, annunciators, direct and indirect lighting, and the latest in plumbing and hospital equipment throughout.

The hospital has a bed capacity of 838 beds, which can be increased to about 1,200 in emergency.

The entirely detached structures of the hospital are the power plant and shops, and the admitting and dispensary building. Here the individuals suffering with ailments not considered serious enough to warrant care in hospital are treated and prescribed for.



Details of Section C.

The Board of Health Laboratory is designed for research and study of tropical diseases and contains the offices and especially equipped work rooms of the chemist, bacteriologist, pathologist, entomologist, embalmer, photographer, library, and other offices. An inclosed passage communicates with the Crematory.

The nurses' home is a three-story building, with social hall and individual rooms and porch for 72 nurses.

The superintendent's residence is the only permanent building so far erected for the staff of Ancon Hospital. It is contemplated in the future to erect a series of concrete buildings to provide quarters for the rest of the staff.

Ancon Hospital is the largest hospital on the Western Hemisphere south of the United States. It is also the only hospital in this region that is able to handle any class of cases, as it has all the modern equipment and apparatus necessary for diagnostic purposes and operative procedure.

In addition to the buildings described above the insane department is located about three miles from Ancon, at Corozal. This institution is comprised of a number of wooden buildings, two stories in height, specially adapted for the housing and treatment of insane patients. There, too, are maintained the chronic cases who are able to do a certain amount of work and who do not wish to be repatriated. Cripples, who have been injured in the line of duty while employed with The Panama Canal and who do not desire to be returned to their native land, are taken care of at Corozal and perform such work on the farm, piggery, and dairy which are located there as they are able to do.

The total number of admissions to Ancon and Corozal Hospitals during the fiscal year ending June 30, 1920, was 10,393. The average number of patients treated per day was approximately 882. During the year 1,994 major and 4,831 minor surgical operations were performed; 3,134 cases visited the out-patient department of the surgical clinic, for whom 391 prescriptions were written; 314 obstetrical cases were delivered. In the out-patient department of the medical clinic 2,611 cases were treated, for whom 1,707 prescriptions were written. In the out-patient department of the eye and ear clinic 7,443 cases were visited for whom 2,606 prescriptions were written; 967 refractions were made and 976 operations performed. In the X-ray clinic, 3,333 cases were handled; 7,197 plates and 1,708 dental films were taken and 84 treatments given. In the dispensary (district physician) 104,737 were treated.

Board of Health Laboratory in the Distance; Crematory in the Foreground.

Ancon Hospital, while a United States Government institution, is not a military hospital, although all Military and Naval persons on the Canal Zone needing hospital treatment are sent there. The superintendent, since it was taken over by the Americans, has always been an officer of the Medical Corps of the United States Army.

The professional staff of Ancon Hospital, including the insane department, at Corozal, are all appointed from civil life with Civil Service status and consists of 33 physicians and 6 internes, including a chief of medical; surgical; eye, ear, nose and throat; X-ray clinic; and chief of laboratory. All the physicians devote their entire time to hospital work and do not engage in private practice.

The nursing service consists of a chief nurse and 90 graduate nurses appointed from civil life with civil service status. In addition there are employed 126 colored attendants and 47 maids, mostly Jamaicans, trained for nursing service.

The construction of New Ancon Hospital was begun in August, 1915, and completed in June, 1919, at a cost of nearly $2,000,000. The present equipment represents nearly another million. It has been proclaimed by many as the most beautiful hospital in the world. Americans can well be proud of having such an institution located as it is midway on the Western Hemisphere, to which all peoples, of whatever race, color, or condition can gain access for treatment of any disease to which the human race is heir, with assurance that it will be the best obtainable anywhere. It is money well spent and has been, as it will continue to be, an important factor in creating better feeling for us among the Latin-Americans and will be the means of dissemination of knowledge of hygiene, sanitation and prevention of disease, with the ultimate result that all quarantinable diseases will disappear from the Western Hemisphere, as every patient from South or Central America, in addition to being cured of their ailment, will observe the excellent results of the health department of the Canal Zone in its campaign against disease, which has converted a "pest hole" of former days into a health resort, where formerly the white man came to die while now they come to be restored to health.

This claim may seem visionary; however, what has been accomplished in the Canal Zone in the way of sanitation and prevention of disease is possible elsewhere, and, if the healthful conditions which now exist in the Canal Zone as a result of the health department's efforts prevailed in other countries of Central and South America there would be no need of any quarantine restrictions.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

Tenth Annual Session, Montreal, October 11-15, 1920

GEORGE E. ARMSTRONG, President — ALBERT J. OCHSNER, Treasurer
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OSCAR F. MERCIER
EUGENE ST. JACQUES
JOHN W. STIRLING
FREDERICK J. TEES

GENERAL PLANS FOR THE MONTREAL MEETING

THE tenth annual session of the Clinical Congress of American College of Surgeons to be held in Montreal, October 11 to 15, will formally open with the Presidential Meeting on Monday evening in St. James Methodist Church. Following the general plans of previous sessions, the morning and afternoon hours of Tuesday, Wednesday, Thursday, and Friday will be devoted to operative clinics and demonstrations in the hospitals and medical schools. On Tuesday, Wednesday, and Thursday evenings, formal sessions will be held in the Ballroom of the Windsor Hotel, and on Friday evening the eighth convocation of the American College of Surgeons will be held in St. James Methodist Church at which time fellowship in the College will be conferred upon a large group of American and Canadian surgeons. In the following pages is presented the program for the several evening meetings as arranged by the Executive Committee of the Clinical Congress.

Under the supervision of the Montreal Committee on Arrangements, of which Dr. George E. Armstrong is Chairman, a program of clinics and demonstrations that will fully represent the clinical activities of Montreal is being prepared. All departments of surgery are to be represented, including gynecology, obstetrics, urology, orthopedics, surgery of the eye, ear, nose, throat, and mouth, roentgenology, experimental surgery, surgical pathology, etc. A preliminary schedule of these clinics and demonstrations is published in the following pages, but the real program of the Congress will be bulletined each afternoon at headquarters, giving in detail the cases to be operated upon and demonstrated in the several clinics on the following day. A printed program will be issued each morning.

Each afternoon at 2:30 o'clock there will be presented in the Ballroom of the Windsor Hotel a series of clinical demonstrations manned by Montreal surgeons and participated in by a number of the visiting surgeons. The complete program for these demonstrations will be found in the following pages.

BUSINESS MEETINGS

TUESDAY—11 a.m. in the Ballroom of the Windsor Hotel Members of the executive committes of those states which have already organized state sections of the Clinical Congress will meet with the President and the Secretary-General to discuss plans for the conduct of clinical meetings in their respective states.

WEDNESDAY—10 a.m. in the Ballroom of the Windsor Hotel. Congressional representatives from Alabama, Arkansas, Delaware, Florida, Georgia, Kansas, Maryland, Mississippi, Nevada, New Jersey, New Mexico, Oklahoma, South Carolina, Virginia, West Virginia and Wyoming will meet with the President and the Secretary-General to discuss plans for the organization of state sections of the Clinical Congress in their respective states.

WEDNESDAY—11 a.m. in the Ballroom of the Windsor Hotel. Canadian fellows of the American College of Surgeons are invited to meet with the President and the Secretary-General of the College to discuss plans for the organization of provincial sections of the Clinical Congress and to elect representatives for the several parliamentary districts in each province.

THURSDAY—4 p.m. in the Ballroom of the Windsor Hotel. Annual business meeting of the American College of Surgeons and the Clinical Congress.

HEADQUARTERS

General headquarters for the Congress will be at the Windsor Hotel, which is centrally located as regards all the hospitals. Practically the entire second floor of the hotel has been reserved for the use of the Congress. The Ballroom will be utilized for the evening sessions and certain clinical demonstrations in the afternoons. Other large rooms on the same floor will be utilized for the registration and ticket bureau, bulletin rooms, etc.

LIMITED ATTENDANCE—HOTEL ACCOMMODATIONS

Because of limited hotel facilities in Montreal, it has been found necessary to place the matter of reserving hotel accommodations for the visiting surgeons in the hands of a committee, and applications for accommodations should be made to Dr. Alfred T. Bazin, Chairman of the Committee on Hotels, 836 University Street, Montreal. This committee will undertake to provide accommodations only for those who have registered in advance at the office of the Clinical Congress in Chicago.

In addition to the Windsor, Ritz Carlton, Place Viger, Queen's, St. Lawrence Hall, Corona, Prince of Wales, Wilhemina and Freeman's hotels, the Committee has arranged for the use of one or two large steamships to be berthed at Victoria Pier. These steamships will afford comfortable accommodations for several hundred visitors. Questionnaires have been sent out by the Committee on Hotels to all who have registered and accommodations have been assigned to all who have returned their questionnaires.

Attendance at all scientific sessions and clinical demonstrations will necessarily be restricted to those surgeons who have registered for the Congress, and because of limited hotel and hospital facilities it will be necessary to enforce strictly the rule of limiting the attendance, requiring registration in advance on the part of those who expect to attend. A survey of the amphitheaters, lecture rooms and laboratories in the several hospitals and medical schools as to their capacity for accommodating visitors has been made, and the limit of attendance based thereon. When the limit of attendance has been reached through advance registration, no further applications will be accepted, which will be disappointing to many surgeons who have attended previous meetings, although the necessity for enforcing this rule will be apparent to all. This plan insures accommodations for all who register in advance, and in view of the limited hotel and clinical facilities only those who have registered may expect to be accommodated.

RAILWAY FARES AND TRAFFIC ARRANGEMENTS

On account of the meeting in Montreal, the Canadian railways have granted reduced fares under certain conditions, which provide that persons attending shall purchase one-way ordinary first-class adult fare tickets (the fare for which must be not less than 75 cents) to Montreal, and secure certificates to that effect on standard convention certificate forms which must be deposited upon arrival, with the General Manager of the Clinical Congress, Mr. A. D. Ballou, at headquarters at the Windsor Hotel, for his endorsement and validation by the special agent of the railway companies. The reduction in fare applies on the return trip, which must be made by the same route as traveled to Montreal, and the amount of the reduction is dependent upon the number in attendance. A fee of 25 cents must be paid at the time of depositing this certificate with the General Manager.

In accordance with the above arrangement, tickets to Montreal will be sold in the territory covered by the eastern Canadian lines from October 7 to 13, the return tickets being good up to and including October 19. In the territory covered by the western lines, in Manitoba, Saskatchewan, and Alberta, tickets to Montreal will be sold from October 6 to 9 inclusive, and in British Columbia from October 4 to 7 inclusive. Tickets for the return trip will be honored up to and including October 10.

While the railways of the United States have declined to grant any reduction in fare for the meeting in Montreal, the railways have been notified of the plans for the meeting so that they will be prepared to handle the extra traffic.

SPECIAL TRAIN FROM CHICAGO

For the convenience of surgeons living in the central and western states who would travel through the Chicago and Detroit gateways, arrangements have been made for a special train via the Michigan Central and Canadian Pacific Railroads to leave Chicago, Twelfth Street Station, at 1:00 p.m., Central standard time, Sunday, October 10, to arrive in Montreal at 1:00 p.m., Eastern standard time, Monday. This train will consist of observation compartment, standard sleeping, club and dining cars. Application for Pullman space on this special train should be made to Mr. R. B. Holmes, Assistant General Passenger Agent, Michigan Central Railroad, Room 412, LaSalle Street Station, Chicago. Pullman tickets may be purchased in Chicago at the Consolidated Ticket Office, 175 West Jackson Boulevard, or at the Twelfth Street Station. The New York Central Lines are making special arrangements to care for the traffic from eastern states via Buffalo and Toronto, Buffalo and Utica, or Albany.

CLINIC TICKETS

Attendance at all clinics and demonstrations is controlled by means of special clinic tickets, the number of tickets issued for any clinic or demonstration being limited to the capacity of the room in which the clinic or demonstration is to be given. As a general rule, one may secure two tickets for each day, one for a morning and one for an afternoon clinic, but for certain clinics, where the accommodations are limited and the demand for tickets is heavy, the rule will be that a visitor may have but one ticket for such clinic during the week. The use of these tickets has proven an efficient means of providing for the distribution of visitors among the several clinics and insures against overcrowding.

Clinic tickets will be issued at headquarters each morning at 8 o'clock for the clinics and demonstrations to be given that day, a complete schedule of the day's clinics having been posted on the bulletin boards at headquarters on the afternoon of the preceding day. After the program has been posted, reservations for clinic tickets for the next day's clinics may be filed, the tickets to be issued the next morning. Printed programs will be issued each morning containing complete program for the day, announcements of the evening session, business meetings, etc.

REGISTRATION FEE

A registration fee is required of each surgeon attending the annual clinical meeting, the receipts from registration fees providing the funds with which to meet the expenses of preparing for and conducting such meetings, so that no financial burden is imposed upon the members of the profession in the city entertaining the Congress.

A formal receipt for the registration fee is issued to each surgeon registering in advance, which receipt is to be exchanged for a general admission card at headquarters upon his arrival in Montreal. This card, which is non-transferable, must be presented to secure clinic tickets and admission to the evening meetings. Headquarters at the Windsor Hotel will be open for registration on Monday, October 11. The clinical program for Tuesday will be bulletined at headquarters on Monday afternoon, and tickets for Tuesday's clinics will be issued as visiting surgeons register.

SPECIAL CLINICAL DEMONSTRATIONS

IN THE BALLROOM OF THE WINDSOR HOTEL

Tuesday, October 12, 2:30 P. M.

LOUIS GROSS, M.D., Montreal: Anatomical Studies in the Circulation of the Blood.
Discussion: HORST OERTEL, M.D., Montreal; GEORGE D. STEWART, M.D., New York; E. L. KEYES, JR., M.D., New York.

JOHN FRASER, M.D., Montreal: Circulation of the Uterus.
Discussion: JOHN G. CLARK, M.D., Philadelphia; RICHARD R. SMITH, M.D., Grand Rapids, Mich.

E. W. ARCHIBALD, M.D., Montreal: Cinematographic Demonstration of the Sphincteric Action of the Common Bile Duct.
Discussion: JOHN B. DEAVER, M.D., Philadelphia.

F. A. C. SCRIMGER, M.D., V.C., Montreal: Massive Collapse of the Lung.
Discussion: A. L. LOCKWOOD, M.D., Rochester, Minn.

Wednesday, October 13, 2:30 P. M.

SYMPOSIUM: Differential Diagnosis of Lesions of the Right Side of the Abdomen.
GEORGE W. CRILE, M.D., Cleveland: General introduction.
SIR BERKLEY MOYNIHAN, C.B., M.S., F.R.C.S., Leeds, England: Duodenal Ulcer.
F. F. BURGHARD, F.R.C.S., London, England: Intussusception.
R. E. MCKECHNIE, M.D., Vancouver: Appendicitis.
E. W. ARCHIBALD, M.D., Montreal: Colonic Tuberculosis.
E. S. JUDD, M.D., Rochester, Minn : Pancreas.
A. E. GARROW, M.D., Montreal: Liver and Bile Passages.
B. P. WATSON, M.D., Toronto: Gynecological.
J. BENTLEY SQUIER, M.D., New York: Urological.
R. C. COFFEY, M.D., Portland, Oregon: Non-organic.

Thursday, October 14, 2:30 P. M.

FULTON RISDON, M.D., Toronto: Mandibular Bone-grafts and Facial Reconstruction Surgery.
Discussion: CLARENCE L. STARR, M.D., Toronto; HANFORD MCKEE, M.D., Montreal.

F. H. MACKAY, M.D., and F. J. TEES, M.D., Montreal: Diagnosis and Treatment of Peripheral Nerve Injuries.
Discussion: A. CARLESS, F.R.C.S., London, England.

C. B. KEENAN, M.D., Montreal: Late Results of Foreign Bodies in the Lung.
Discussion: WILLY MEYER, M.D., New York; F. G. FINLEY, M.D., Montreal; SIR BERKLEY MOYNIHAN, C.B., M.S., F.R.C.S., Leeds, England.

JOHN A. GUNN, M. D., Winnipeg: Treatment of Fractures of the Femur.
Discussion: DR. LEMESURIER, Toronto; SIR WILLIAM TAYLOR, C.B., Dublin.

Friday, October 15, 2:30 P. M.

ALFRED T. BAZIN, M.D., Montreal: Acute Empyema.
Discussion: E. M. EBERTS, M.D., Montreal; HOMER GAGE, M.D., Worcester, Mass.

JOHN H. CUNNINGHAM, M.D., Boston: Metastatic Gonorrhœal Arthritis.
Discussion: FRED B. LUND, M.D., Boston; HUGH H. YOUNG, M.D., Baltimore.

W. E. GALLIE, M.D., Toronto: Demonstration of the Pathological Changes in Bone Regeneration.
Discussion: F. H. ALBEE, M.D., New York; D. B. PHEMISTER, M.D., Chicago.

F. E. MCKENTY, M.D., F.R.C.S., Montreal: Blastomycosis.

PRELIMINARY CLINICAL PROGRAM

MONTREAL GENERAL HOSPITAL

Tuesday, October 12

J. A. HUTCHISON—9:00. Surgical clinic, cholelithiasis.
J. M. ELDER—9:00. Surgical clinic, septic infection of the knee-joint.
H. D. HAMILTON and R. H. CRAIG—9:00. Ear, nose and throat clinic.
G. H. MATHEWSON and H. MCKEE—9:00. Eye clinic.
DR. HARVEY—9:00. Remedial gymnastics.
F. J. TEES and F. B. GURD—9:00. Fracture clinic.
F. A. L. LOCKHART—2:00. Gynecological operations.
H. D. HAMILTON and R. H. CRAIG—2:00. Ear, nose and throat clinic.
F. S. PATCH and R. E. POWELL—2:00. Genito-urinary clinic.
G. H. MATHEWSON and H. MCKEE—2:00. Eye clinic.
A. M. FORBES and J. A. NUTTER—2:00. Orthopedic clinic.

Wednesday, October 13

A. T. BAZIN—9:00. Surgical clinic, operative treatment of hernia, demonstration of fascia transplation.
E. M. EBERTS—9:00. Surgical clinic, type lesions of gastric ulcer.
H. D. HAMILTON and R. H. CRAIG—9:00. Ear, nose, and throat operations.
G. H. MATHEWSON and H. MCKEE—9:00. Eye clinic.
DR. HARVEY—9:00. Remedial gymnastics.
F. J. TEES and F. B. GURD—9:00. Fracture clinic.
G. H. MATHEWSON—2:00. Operations on the eye.
H. D. HAMILTON and R. H. CRAIG—2:00. Ear, nose, and throat clinic.
F. S. PATCH and R. E. POWELL—2:00. Genito-urinary clinic.
H. M. LITTLE and DR. PATRICK—2:00. Gynecological clinic.
A. M. FORBES and J. A. NUTTER—2:00. Orthopedic clinic.

Thursday, October 14

J. M. ELDER—9:00. Surgical clinic, empyema.
J. A. HUTCHISON—9:00. Surgical clinic.
H. D. HAMILTON and R. H. CRAIG—9:00. Ear, nose, and throat operations.
G. H. MATHEWSON and H. MCKEE—9:00. Eye clinic.
DR. HARVEY—9:00. Remedial gymnastics.
F. J. TEES and F. B. GURD—9:00. Fracture clinic.
A. M. FORBES and J. A. NUTTER—2:00. Orthopedic operations.
H. D. HAMILTON and R. H. CRAIG—2:00. Ear, nose, and throat clinic.
F. S. PATCH and R. E. POWELL—2:00. Genito-urinary clinic.
G. H. MATHEWSON and H. MCKEE—2:00. Eye clinic.
H. M. LITTLE and DR. PATRICK—2:00. Gynecological clinic.

Friday, October 15

E. M. EBERTS—9:00. Surgical clinic, operative treatment of appendicitis with special regard to the prevention of wound infection.
A. T. BAZIN—9:00. Surgical clinic, abscess of the lung, traumatic paraplegia.
H. D. HAMILTON and R. H. CRAIG—9:00. Ear, nose, and throat operations.
G. H. MATHEWSON and H. MCKEE—9:00. Eye clinic.
DR. HARVEY—9:00. Remedial gymnastics.
F. J. TEES and F. B. GURD—Fracture clinic.
F. S. PATCH and R. E. POWELL—2:00. Genito-urinary operations, prostatectomy, pyelitis, kidney function in urological operations.
H. D. HAMILTON and R. H. CRAIG—2:00. Ear, nose, and throat clinic.
G. H. MATHEWSON and H. MCKEE—2:00. Eye clinic.
H. M. LITTLE and DR. PATRICK—2:00. Gynecological clinic.
A. M. FORBES and J. A. NUTTER—2:00. Orthopedic clinic.

ROYAL VICTORIA HOSPITAL

Tuesday, October 12

A. E. GARROW—9:00. Surgical operations.
W. W. CHIPMAN—9:00. Prolapsus uteri, sacro-pubic hernia. Operations and presentation of cases.
C. B. KEENAN—9:00. Cases of cranioplasty, spinal cord injuries in soldiers, chylous effusion in pleura.
E. W. ARCHIBALD—9:00. Demonstration of X-ray plates of thoracoplasty for pulmonary tuberculosis; specimen of tuberculous bowel.
J. A. MACMILLAN—9:00. West operation with anatomical demonstration by Professor Whitnall.
W. H. P. HILL—2:00. Surgical operations.
W. G. TURNER—2:00. Orthopedic operations.
Ear, nose, and throat clinic—3:30. Tonsil and adenoid operations, special cases.

Wednesday, October 13

G. E. ARMSTRONG—9:00. Surgical operations.
D. W. MACKENZIE—9:00. Urological operations.
F. A. C. SCRIMGER—9:00. Demonstration: Six cases of penetrating defects in long bones, infected, filled with pedicled muscle flaps; five cases of massive collapse of lung; series of amputations and results; obstruction of duodenum.
F. T. TOOKE and DR. PIRIE—9:00. Clinical and pathological demonstration of ocular tuberculosis; demonstration of a new method of localizing foreign bodies in the eye and also of a new retinometer.
H. C. BURGESS—2:00. Gynecological clinic: The treatment of abortion.
W. G. TURNER—2:00. Demonstration of orthopedic cases.
Ear, nose, and throat clinic—3:00. Operations on septum and accessory sinuses.

Thursday, October 14

E. W. ARCHIBALD—9:00. Surgical operations.
W. W. CHIPMAN—9:00. Gynecological clinic: The chronic inflammatory pelvis.
C. B. KEENAN—9:00. Demonstration of late results of foreign bodies in the lungs.
W. G. TURNER—9:00. Demonstration: Cases of Brodie's abscess; old shoulder injuries (military and civil).
J. A. MACMILLAN—9:00. West operation with anatomical demonstration by Professor Whitnall.
F. A. C. SCRIMGER—2:00. Surgical operations.

W. G. TURNER and W. J. PATTERSON—2:00. Orthopedic operations.
Ear, nose, and throat clinic—3:00. Mastoid operations.

Friday, October 15

C. B. KEENAN—9:00. Surgical operations.
D. W. MACKENZIE—9:00. Urological operations.
W. G. TURNER—9:00. Demonstration of recent cases of spinal bone graft, results; bone graft and ununited fractures.
J. W. STIRLING and W. G. M. BYERS—9:00. Corneo-scleral trephining.
F. E. MCKENTY—2:00. Surgical operations.
J. R. FRASER—2:00. Gynecological clinic: Neoplasms.

MONTREAL MATERNITY HOSPITAL

Mornings

W. W. CHIPMAN—Obstetrical operations.
H. M. LITTLE—Normal labor cases.
W. A. G. BAULD—Demonstration of ordinary obstetrical routine.
H. C. BURGESS—Demonstration of the application of forceps.
J. W. DUNCAN—Demonstration of induction of labor.
J. R. FRASER—Intrapartum gynecology.

Afternoons

H. M. LITTLE—Technique of obstetrical operations for hospital and general practice.
J. W. DUNCAN—Routine treatment of vomiting of pregnancy.
H. C. BURGESS—Routine treatment of eclampsia.
J. R. FRASER—Prenatal clinic.

WESTERN GENERAL HOSPITAL

F. R. ENGLAND—Modern treatment of fractures.
J. A. SPRINGLE—General surgery.
GEORGE FISK—Treatment of fractures by mobilization and massage.
C. C. GURD, LORNE GILDAY, and J. J. IRVEN—Gynecological clinics, operations, and demonstration of cases.
F. GILDAY—Orthopedics.
F. J. HACKETT—Treatment of wounds.
R. SCOTT—Treatment of burns.
R. H. CRAIG—Foreign bodies in the bronchus.
R. A. KERRY and A. BRAMLEY-MOORE—Ophthalmology.
CALVIN ROSS—X-ray demonstrations.
GEORGE D. ROBINS—Neurological cases.
A. H. MCCORDICK—Surgical pathology.

HÔTEL DIEU

EUGENE ST. JACQUES and WILLIAM J. DEROME—Tuesday, 9:00. Hysterectomy in simple and complicated cases; thyroidectomy; Calot's method in the treatment of tuberculous cervical adenitis; appendectomy, simplified technique and skin suture.
A. MARIEN and A. ST. PIERRE—Wednesday, 9:00. Treatment of purulent pleurisy.
DONALD HINGSTON and Z. RHEAUME—Thursday, 9:00. Treatment of tuberculous cervical adenitis.
G. BARIL and associates—Demonstration of the Ambard test in the evaluation of functional activities of the kidney, presentation of cases and operation.
LEO PARIZEAU—Demonstration of the value of X-rays in the diagnosis of gall-bladder diseases, followed by operation.
Z. RHEAUME and E. ST. JACQUES—The combined abdomino-pelvic operation for cancer of the rectum, presentation of cases and operation.
A. LASALLE, J. N. ROY, PAUL BOUSQUET, and GEORGE BADEAUX—Eye, ear, nose, and throat clinics.

NOTRE DAME HOSPITAL

O. F. MERCIER, B. S. BOURGEOIS, and DR. PARIZEAU—General surgery; operative clinics and demonstrations; treatment of fractures; surgery of the kidneys; prostatectomy; hypertrophy of the prostate; treatment of burns by tincture of iodine.
L. DE L. HARWOOD—Gynecological clinic; preparation of patients for major operations; medical treatment of inflammatory conditions of the pelvis.
A. A. FOUCHER—Eye clinic; operations and demonstration of cases; optic neuritis (choked disc) in relation to brain disease.
EUGENE PANNETON—Roentgentherapy in some diseases of women; in particular, fibroids of the uterus and metrorrhagia.

HOSPITAL STE. JUSTINE FOR CHILDREN

DR. FERRON—General surgery: operations and demonstration of cases. Congenital deformities of the genital organs.

CHILDREN'S MEMORIAL HOSPITAL

A. MACKENZIE FORBES, H. B. CUSHING and associates—Demonstrations daily, treatment of tuberculosis of bones, scoliosis, infantile paralysis, etc.

PRELIMINARY PROGRAM OF EVENING SESSIONS

Presidential Meeting, Monday, October 11

Address of Welcome: GENERAL SIR ARTHUR WILLIAM CURRIE, G.C.M.G., K.C.B., LL.D., Montreal.
Address of retiring president: WILLIAM J. MAYO, M.D., Rochester, Minn.
Inaugural Address: GEORGE E. ARMSTRONG, M.D., Montreal.
Introduction of foreign guests: SIR BERKELEY MOYNIHAN, Leeds; SIR WILLIAM TAYLOR, C.B., Dublin; A. CARLESS, C.B.E., F.R.C.S., London.
HIS EXCELLENCY, THE RIGHT HONORABLE SIR AUCKLAND C. GEDDES, K.C.B., LL.D., M.D., British Ambassador to the United States.
SIR BERKELEY MOYNIHAN, C.B., M.S., F.R.C.S., Leeds: The John B. Murphy Oration on Surgery.

Tuesday, October 12

SYMPOSIUM: Intestinal Obstruction.
J. M. T. FINNEY, M.D., Baltimore: Acute Intestinal Obstruction.
HARVEY B. STONE, M.D., Baltimore: The Toxic Agents Developed in the Course of Acute Intestina Obstruction and Their Action.
LEGRAND GUERRY, M.D., Columbia: The Pre-Operative Treatment of Intestinal Obstruction.
RUDOLPH MATAS, M.D., New Orleans: The Treatment of Postoperative Ileus with Special Reference to Tympanites as a Defensive Phenomenon.
JOHN E. SUMMERS, M.D., Omaha: Enterostomy in the Treatment of Acute Intestinal Obstruction.
CHARLES H. PECK, M.D., New York: Obstruction of the Colon and Ileocolic Junction.
SYMPOSIUM: Blood Transfusion.
NELSON M. PERCY, M.D., Chicago: Blood Transfusion in Chronic Anæmias.
LILIAN K. P. FARRAR, M.D., New York: Acidosis in Operative Surgery and Its Treatment by Glucose and Gum Acacia Given Intravenously.
Discussion: L. BRUCE ROBERTSON, M.D., Toronto; E. H. MASON, M.D., Montreal.

Wednesday, October 13

CLARENCE L. STARR, M.D., Toronto: Reconstruction Surgery and Its Application to Civilian Practice.
Discussion: JOEL E. GOLDTHWAIT, M.D., Boston; NATHANIEL ALLISON, M.D., St. Louis.
A. CARLESS, C.B.E., F.R.C.S., London: Treatment of Flail Limbs.
SYMPOSIUM: Cancer of the Uterus.
WILLIAM P. GRAVES, M.D., Boston: Present Status of the Treatment of Operable Cancer of the Cervix Uteri.
WILLIAM S. STONE, M.D., New York: The Present Position of Radium in the Study and Treatment of Uterine Cancer.
Discussion: ROBERT B. GREENOUGH, M.D., Boston; HOWARD CANNING TAYLOR, M.D., New York; JOHN G. CLARK, M.D., Philadelphia.

Thursday, October 14

ROBERT C. COFFEY, M.D., Portland: Transplantation of the Ureter into the Large Intestine in the Absence of a Functioning Urinary Bladder.
Discussion: WILLIAM R. CUBBINS, M.D., Chicago.
SYMPOSIUM: The Thyroid and Its Diseases.
E. C. KENDALL, Ph.D., Rochester, Minn.: The Chemical Influences of the Active Constituents of the Ductless Glands.
H. S. PLUMMER, M.D., Rochester, Minn.: The Significance of the Metabolic Rate as Influenced by Thyroid Pathology.
GEORGE W. CRILE, M.D., Cleveland: The Protection of the Patient in Surgery of the Thyroid.
CHARLES H. MAYO, M.D., Rochester, Minn.: The Thyroid and Its Diseases.

Friday, October 15

Convocation of the American College of Surgeons:
Conferring of Honorary Fellowships.
Presentation of Candidates for Fellowship.
Presidential Address: GEORGE E. ARMSTRONG, M.D., Montreal.
Fellowship Address.